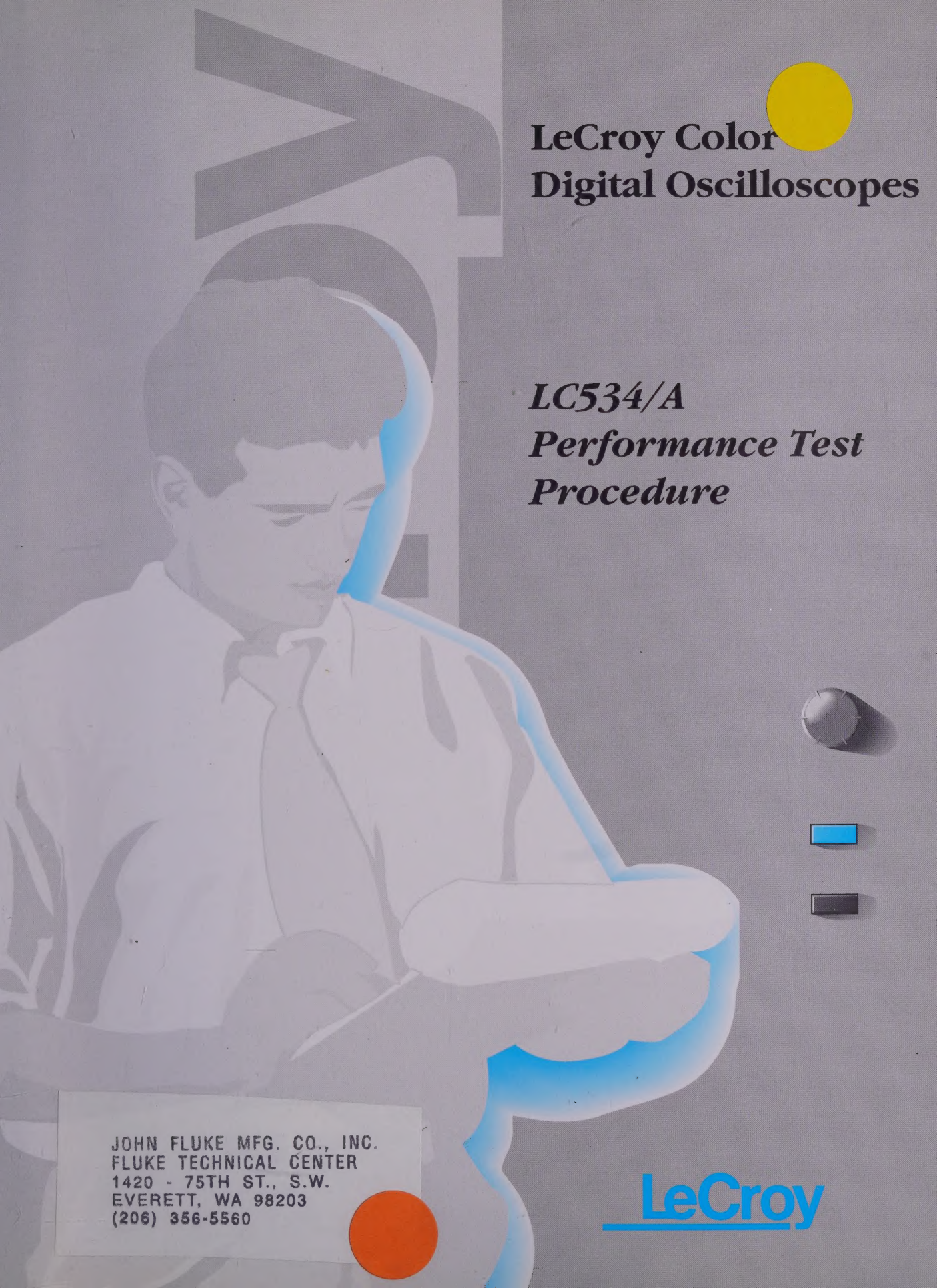
LeCroy Color Digital Oscilloscopes



LC534/A Performance Test Procedure

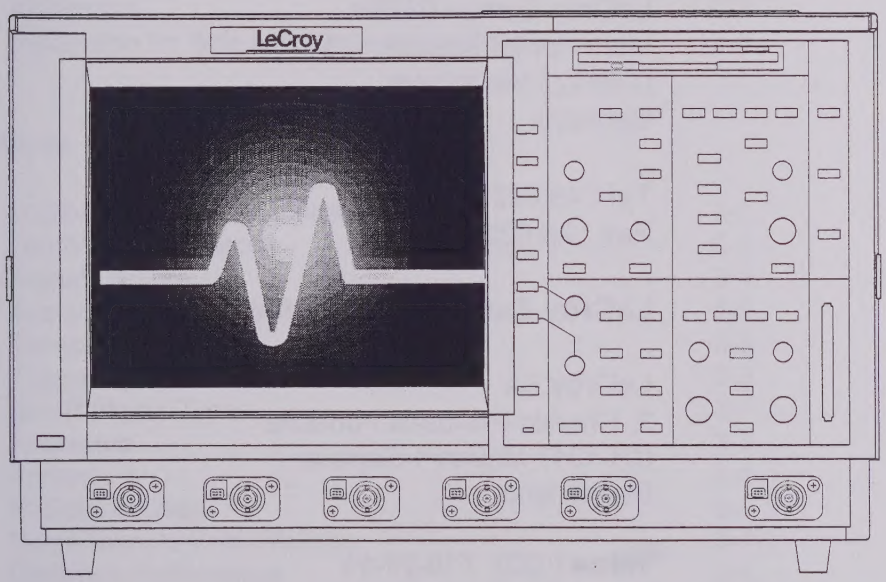
JOHN FLUKE MFG. CO., INC.
FLUKE TECHNICAL CENTER
1420 - 75TH ST., S.W.
EVERETT, WA 98203
(206) 356-5560

LeCroy

LeCroy Color Digital Oscilloscopes

LC534 & LC534A

Performance Test Procedure



Version A – February 1997

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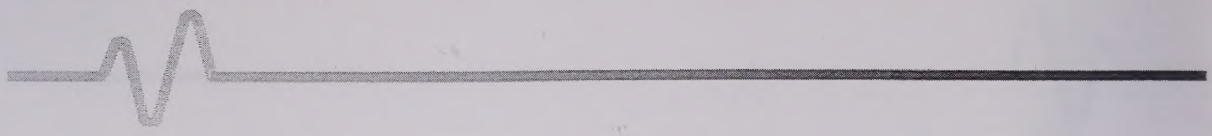

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Information in this publication supersedes all earlier versions.
Specifications subject to change.

LeCroy

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1. Product and Client Care

1.1 As Soon As Your Scope is Delivered

We recommend you thoroughly inspect the contents of the scope packaging at once. Check all the contents against the enclosed *packing list*. Unless LeCroy is notified promptly of a missing or damaged item, we cannot accept responsibility for its replacement. Contact your national LeCroy Customer Service Department or local office immediately.

1.2 Warranty

LeCroy warrants its oscilloscope products for normal use and operation within specifications for a period of three years from the date of shipment. Calibration each year is recommended to ensure in-spec performance. Spares, replacement parts and repairs are warranted for 90 days. The instrument's firmware has been thoroughly tested and is thought to be functional, but is supplied without warranty of any kind covering detailed performance. Products not made by LeCroy are covered solely by the warranty of the original equipment manufacturer.

In exercising its warranty, LeCroy will repair or, at its option, replace any product returned within the warranty period to the Customer Service Department or an authorized service center. However, this will be done only if the product is determined by LeCroy's examination to be defective due to workmanship or materials, and the defect has not been caused by misuse, neglect or accident, or by abnormal conditions or operation.

The client will be responsible for the transportation and insurance charges for the return of products to the service facility. LeCroy will return all products under warranty with transport prepaid.

This warranty replaces all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract or otherwise.

1.3 Maintenance Agreements

We provide a variety of customer support services. Maintenance agreements give extended warranty and allow our clients to budget maintenance costs after the initial three-year warranty has expired. Other services such as installation, training, enhancements and on-site repairs are available through special Supplemental Support Agreements

1.4 Keeping You Up to Date

LeCroy is dedicated to offering state-of-the-art instruments, continually refining and improving the performance of our products. Because of the speed with which physical modifications may be implemented, this manual and related documentation may not agree in every detail with the products they describe. For example, there might be small discrepancies in the values of components affecting pulse shape, timing or offset, and — infrequently — minor logic changes.

However, be assured the scope itself is in full order and incorporates the most up-to-date circuitry. We frequently update firmware or software during servicing to improve scope performance, free of charge during warranty. We will keep you up to date with such changes, through manuals such as this one and other publications.

1.5 Service and Repair

Please return products requiring maintenance to the Customer Service Department in your country or to an authorized service facility. LeCroy will repair or replace any product under warranty free of charge. The customer is responsible for transportation charges to the factory, whereas all in-warranty products will be returned to you with transportation prepaid.

Outside the warranty period, you will need to provide us with a*purchase order number* before we can repair your LeCroy product. You will be billed for parts and labor related to the repair work, and for shipping.

1.6 How to Return a Product

Contact your country's Customer Service Department or local field office to find out where to return the product. All returned products should be identified by model and serial number. You should describe the defect or failure, and provide your name and contact number. And in the case of products returned to the factory, a *Return Authorization Number* (RAN) should be used. The RAN can be obtained by contacting your nearest LeCroy office, or the New York Customer Care Center or European Manufacturing in Geneva (*see chapter 2 for contact numbers*).

Return shipments should be made prepaid. We cannot accept COD (Cash On Delivery) or Collect Return shipments. We recommend air-freighting. It is important that the RAN be clearly shown on the outside of the shipping package for prompt redirection to the appropriate LeCroy department.

Wherever possible, use the original shipping carton. If a substitute carton is used, it should be rigid and packed so that that the product is surrounded by a minimum of four inches or 10 cm of shock-absorbent material.

2. General Information

2.1 Product Assistance

Help on installation, calibration, and the use of LeCroy equipment is available from your local LeCroy office, or from LeCroy's

- Customer Care Center, 700 Chestnut Ridge Road, Chestnut Ridge, New York 10977–6499, U.S.A., tel. (914) 578–6020
- European Manufacturing, 2, rue du Pré-de-la-Fontaine, 1217 Meyrin 1, Geneva, Switzerland, tel. (41) 22/719 21 11.

2.2 Addresses

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N-1252 Oslo
Norway

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Fax : 47.22.610759

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184 24 Akersberga
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Fax : 46.8.540.665.36

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Causeway Bay

Tel : 852.28367361
Fax : 852.28367007

Philips Scientific & Industrial Electronics
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North Ryde NSW 2113
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Tel : 61 2 98888222
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Abex Engineering Pte. Ltd.
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Tong Lee Building Block B
Singapore 1334

Tel : 65.8412818
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Fax : 886.2.231.9731

Schmidt Electronics Ltd
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Fax : 852.2827.5656

Electro Tech Corporation
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Shaheed-Millat/Jamaludding
Karachi-74800 Pakistan

Tel : 92.21.493-9593
Fax : 92.21.493-7749

Tata-Honeywell
55-A/8 & 9 Hadapspar
Indusrial Estate
Pune 411 013 India

Tel : 91.212.675.532
Fax : 91.212.672.205

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P.t. Dwi Tunggal Jaya Sakti
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Sitemas De Instrumentation
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Casilla 51888 Stgo-1
Santiago Chile

Tel : 56.2.6951137
Fax : 56.2.6969665

ATP-Hi-Tek
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Baruei, Sp Brazil

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Fax : 55.11.421.5032

Electroingenieria De Precision
Uxmal No 520
Col Vertiz Narvarte
03600 Mexico

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Fax : 525.575-3381

South Africa

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376 Oak Avenue
Randburg 2194
Republic of South Africa

Tel : 27.11.787.0473
Fax : 27.11.787.0237

2.3 Installation for Safe and Efficient Operation

Operating Environment

The oscilloscope will operate to its specifications if the environment is maintained within the following parameters:

Temperature .....5 to 40 °C (41 to 104 °F) rated.

Humidity .....Maximum relative humidity 80 % RH (non-condensing) for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C

Altitude.....2000 m (6560 ft)

The oscilloscope has been qualified to the following EN61010-1 category:

Installation (Overvoltage) CategoryII

Pollution Degree.....2

Safety Symbols

Where these symbols or indications appear on the front or rear panels, and in this manual, they have the following meanings:

..... **CAUTION**: Refer to accompanying documents (for Safety-related information). *See elsewhere in this manual wherever the symbol is present,as indicated in the Table of Contents.*

..... **CAUTION**: Risk of electric shock

..... **On (Supply)**

..... **Off (Supply)**

..... **Earth (Ground) Terminal**

.... **Protective Conductor Terminal**

..... **Earth (Ground) Terminal on BNC Connectors**

WARNING ..... **Denotes a hazard. If a WARNING is indicated on the instrument, do not proceed until its conditions are understood and met.**

Any use of this instrument in a manner not specified by the manufacturer may impair the instrument's safety protection.

The oscilloscope has *not* been designed to make direct measurements on the human body. Users who connect a LeCroy oscilloscope directly to a person do so at their own risk.

Power Requirements

The oscilloscope operates from a 115 V (90 to 132 V) or 220 V (180 to 250 V) AC power source at 45 Hz to 66 Hz. No voltage selection is required, since the instrument automatically adapts to the line voltage present.

The power supply of the oscilloscope is protected against short-circuit and overload by means of two 6.3 A/250 V AC, "T" rated fuses (size: 5 X 20 mm), located above the mains plug. Disconnect the power cord before inspecting or replacing a fuse. Open the fuse box by inserting a small screwdriver under the plastic cover and prying it open.

For continued fire protection at all line voltages, replace only with fuses of the specified type and rating (T 6.3 A/250 V).

The oscilloscope has been designed to operate from a single-phase power source, with one of the current-carrying conductors (neutral conductor) at ground (earth) potential.

Maintain the ground line to avoid an electric shock.

None of the current-carrying conductors may exceed 250 V rms with respect to ground potential. The oscilloscope is provided with a three-wire electrical cord containing a three-terminal polarized plug for mains voltage and safety ground connection.

The plug's ground terminal is connected directly to the frame of the unit. For adequate protection against electrical hazard, this plug must be inserted into a mating outlet containing a safety ground contact.

Cleaning And Maintenance

Maintenance and repairs should be carried out exclusively by a LeCroy technician (*see* Chapter 2). Cleaning should be limited to the exterior of the instrument only, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances should moisture be allowed to penetrate the oscilloscope. To avoid electric shocks, disconnect the instrument from the power supply before cleaning.

CAUTION Risk of electrical shock: No user serviceable parts inside. Leave repair to qualified personnel.

Power On

Connect the oscilloscope to the power outlet and switch it on by pressing the power switch located on the rear panel. After the instrument is switched on, auto-calibration is performed and a test of the oscilloscope's ADCs and memories is carried out. The full testing procedure takes approximately 10 seconds, after which time a display will appear on the screen.

3. LC534 & LC534A Specifications

3.1 Leading Specifications

- 1 GHz Bandwidth
- 2 GS/s Single-shot Sample Rate
- 8 Million Points of Acquisition Memory
- 4 ms Maximum Sample Rate Window
- 96 MHz PowerPC Microprocessor
- 8 to 64 Mbytes System RAM
- 9" Color Display
- Analog Persistence
- Full Screen Grid

Digital oscilloscopes from LeCroy are designed to save engineers valuable time in troubleshooting and problem-solving.
Each oscilloscope is an integrated and powerful system providing the capability to:

- **Capture** the key events with high resolution for longer time intervals
- **View** data like never before, giving you more information more quickly, with a large, color CRT and advanced display techniques
- **Analyze** your signal to get answers quickly and more accurately with a powerful processing system and math packages.

3.2 Signal Capture

Acquisition System
Bandwidth (-3 dB):
@ 50Ω: DC to 1 GHz
@ 1 MΩ DC:DC to 500 MHz typ. at probe tip, with PP005 supplied as standard
No. of Channels: 4
No. of Digitizers: 4 at 500 MS/s, 2 GS/s single channel mode.
Max. Sample Rate Window: 4 ms @ 2 GS/s in single-shot mode.
Sensitivity:
50Ω : 2 mV/div to 1 V/div for LC534A, 5 mV/div to 1V/div for LC534.
1MΩ·: 2 mV/div to 10 V/div for LC534A, 5 mV/div to 10V/div for LC534
Scale factors: A wide choice of probe attenuation factors are selectable.
Offset Range:

5.00-99 mV/div:	±1 V
0.1-1.0 V/div:	±10 V
1.0-10 V/div:	± 100 V (1MΩ only)

DC Accuracy: Typically 1%.
Vertical Resolution: 8 bits.
Bandwidth Limiter: 25 MHz, 200 MHz.
Input Coupling: AC, DC, GND.
Input Impedance: 10MΩ//11pF (system capacitance using PP005) or 50 Ω ±1%.

Max Input:
50 Ω: ±5 V DC (500 mW) or 5 V RMS.
1 MΩ: 400 V (DC+ peak AC ≤10 kHz).

Channel use	Maximum Sample Rate	LC534 LC534A	LC534M LC534AM	LC534L LC534AL	Active Channels
All Peak Detect Off	500 MS/s	100 k	500 K	2 M	All
Paired Peak Detect Off	1 GS/s	250 k	1 M	4 M	Ch2&Ch3
Paired+Adapter Peak Detect Off	2 GS/s	500 k	2 M	8 M	One
All Peak Detect On	100 MS/s data + 400 MS/s peaks	50 k data + 50 k peaks	250 k data + 250 k peaks	1 M data + 1 M peaks	All 2.5 ns Peak Detect

SMARTMemory: This total memory management system dynamically manages acquisition memory to guarantee that signals are always sampled at the highest possible sample rate and that system RAM and microprocessor power resources are always optimally employed.

3.3 Acquisition Modes

Random Interleaved Sampling (RIS):
For repetitive signals from 1 ns/div to 5 µs/div.
Single shot:
For transient and repetitive signals from 10 ns/div (all channels active).
Peak detect: Captures and displays 2.5 ns glitches or other high-speed events, while simultaneously capturing normally sampled data.
Sequence: Stores multiple events in segmented acquisition memories.
Dead Time between segments: Typically < 30 µs, max. 50 µs.

Number of segments available:
LC534, LC534A : 500.
LC534M, LC534AM : 2,000.
LC534L, LC534AL : 2,000.

3.4 Timebase System

Timebases: Main and up to 4 Zoom Traces.
Time/Div Range: 1 ns/div to 1,000 s/div.
Clock Accuracy: ≤10 ppm.
Interpolator resolution: 10 ps.
Roll Mode: Ranges 500 ms to 1,000 s/div.
For > 50k points: 10 s to 1,000 s/div.
External Clock: ≤100 MHz on EXT input with ECL, TTL or zero crossing levels.
Optional 50 MHz to 500 MHz rear panel fixed frequency clock input.
External Reference: Optional 10 MHz rear-panel input.

3.5 Triggering System

Modes: Normal, Auto, Single, and Stop.
Sources: CH1, CH2, CH3, CH4 Line, Ext, Ext/10. Slope, Level and Coupling are unique to each source.
Slope: Positive, Negative.
Coupling: AC, DC, HF, LFREJ, HFREJ.
Pre-trigger recording: 0 to 100% of full scale (adjustable in 1% increments).
Post-trigger delay: 0 to 10,000 divisions (adjustable in 0.1 div increments).
Holdoff by time: 10 ns to 20 s.
Holdoff by events: 0 to 99,999,999.
Internal Trigger Range: ±5 div.
EXT Trigger Max Input: 10MΩ//11pF (system capacitance using PP005): 400V(DC+peakAC≤10kHz)
50Ω ±1%: ±5 V DC (500 mW) or 5 V RMS.
EXT Trigger Range: ±0.5 V (±5 V with Ext/10).
Trigger Timing: Trigger Date and Time are listed in the Memory Status Menu.
Trigger Comparator: Optional ECL rear panel output. Alternatively, the calibrator output can provide a trigger output or a PASS/FAIL test output.

3.6 Smart Trigger Types

Pattern: Trigger on the logic combination of 5 inputs - CH1, CH2, CH3, CH4, and EXT Trigger, where each source can be de-fined as High, Low or Don't Care. The Trigger can be defined as the beginning or end of the specified pattern.
Signal or Pattern Width: Trigger on width between two limits selectable from ≤ 2.5ns to 20s. Will typically trigger on glitches 1ns wide.
Signal or Pattern Interval: Trigger on interval between two limits selectable from 10ns to 20s.
Dropout: Trigger if the input signal drops out for longer than a time-out from 25ns to 20s.
State/Edge Qualified: Trigger on any source only if a given state (or transition) has occurred on another source. The delay between these events can be defined as a number of events on the trigger channel or as a time interval.
TV: Allows selection of both line (up to 1500) and field number (up to 8) for PAL, SECAM, NTSC or nonstandard video.
Exclusion Trigger: Trigger on inter-mittent faults by specifying the normal width or period of a signal. The oscillo-scope will trigger only on aberrations which are shorter or longer than normal.

3.7 Autosetup

Pressing Autosetup sets timebase, trigger and sensitivity to display a wide range of repetitive signals. (Frequency above 50Hz; Duty Cycle greater than 0.1%).

Autosetup Time: Approximately 2 seconds.
Vertical Find: Automatically sets sens-itivity and offset for selected channel.

3.8 Probes

One PP005 probe is supplied per channel. DC to 500 MHz typical at probe tip, 500 V max.
Probe calibration: Max 1 V into 1 MΩ, 500 mV into 50 Ω, frequency and amplitude programmable, pulse or square wave selectable, rise and fall time 1 ns typical.

3.9 9" Color Display

- LeCroy provides a very large, sharp oscilloscope screen that is 50% larger in total viewing area than a 7" screen.

- Its powerful features include Analog Persistence, Color Graded Persistence, Full Screen mode, Opaque or Transparent display, color association and personal color schemes. These provide the user with outstanding benefits that accelerate visual processing and effective communication of on-screen information.

3.10 Large Sample Rate Window

- Having a high sample rate in a DSO is only the first step to preserving data integrity. The time window over which this sample rate is available is also of critical importance.

- Long acquisition memory maintains the oscilloscope's highest sample rate for large time windows allowing the user to sample long signals with high horizontal resolution.

- With up to 8 million points of acquisition memory the maximum sample rate of these oscilloscopes of 2 GS/s is maintained for a time window of 4ms. This sample rate window - 15 times greater than the maximum sample rate window of competing DSOs - enables the user to record long signals with high resolution.

3.11 Optimum Performance

- SMARTMemory is a Total Memory Management system that dynamically allocates resources of microprocessor power, acquisition memory and processing RAM. The intelligent management provided by SMARTMemory guarantees optimal usage of oscilloscope resources.

- The 96 MHz PowerPC microprocessor at the heart of these DSOs drives the system to produce results fast, providing rapid waveform update and super panel responsiveness.

3.12 Quick Diagnoses

- Capturing and viewing waveforms is fundamental to an oscilloscope. Productivity improvements are accessible by using built-in math functions to assist troubleshooting and diagnoses of circuit problems.

- The signal analysis capability of these DSOs is enhanced by advanced waveform math, spectrum analysis, and waveform parameter analysis. This analysis capability greatly increases the speed with which circuit problems are clearly identified and solved.

3.13 Analog Persistence

- At a push of the green button the user can switch between an analog view and a digital view of signals on these oscilloscopes.

- The depth of signal information can be explored along the third dimension of the waveform display to give the user a complete picture of waveform activity.

- Unlike an analog oscilloscope, all signal data is captured and available in memory for analysis and measurements. Analog Persistence gives the user the best of both the analog and digital world of oscilloscopes.

3.14 Full Screen Grid

- These LeCroy DSOs not only have a very large 9" screen but also provide a display mode with an extra-large grid, up to 150% larger than common grid areas. In Full Screen mode, all of the screen area is used to display signals. This provides a magnificent view of waveforms: signal details are seen more clearly and with greater ease.

3.15 Easy Documentation

- All waveform data and results of analysis can be quickly saved to floppy disk, memory card, ATA flash card, or a removable hard disk. This provides an efficient way to archive information and facilitates easy documentation of results.

- An optional internal graphics printer outputs screen dumps in seconds providing the user with an immediate and clear record of signal activity.

3.16 Signal Viewing

Type: Color 10" Raster Scan CRT, 0.26mm dot pitch.
Resolution: 640 x 480 points.
Display Area: 170mm x 125mm - 50% greater than that of a 7" display.

Controls: Rear-Panel presets for position, brightness and contrast.
Menu controls for brightness and color selection.
Grid Styles: Single, Dual, Quad, XY, Single+XY, Dual+XY, and Full Screen
an enlarged view of each grid style.
Graticules: Internally generated; separate intensity control for grids and waveforms. Selectable blending of grid with displayed traces.
Waveform Style: Dot Join with option-al sample point highlight or Dots only.
Persistence Modes: Color graded persistence and analog persistence, infinite or variable with decay over time. In color graded persistence a color spectrum from red through violet is used to map signal intensity. With Analog Persistence the brightness level of a single color denotes signal intensity. Each trace's persistence data is stored in 64k levels.
Trace Display: Opaque or transparent mode, with overlap management.
Number of Traces: 4 (any mix of channels, memories or Math functions).
Real-time Clock: Date, hours, minutes, seconds.
External Monitor: Rear-panel 15-pin socket for VGA compatible monitor.
Vertical Zoom: Up to 5x vertical ex-pansion to a maximum of 5 mV/div (50x with averaging)
Horizontal Zoom: Waveforms can be expanded to give 2-2.5 points/division. This allows zoom factors up to 100,000x for the 'M' models and up to 400,000x for the 'L' models when channels are combined.

3.17 Signal Analysis

A comprehensive and easy-to-use set of diagnostic tools are available. Calculations are performed rapidly and results can be presented on-screen or stored to disk.
Rapid Processing System
Microprocessor: 96 MHz PowerPC™ 603e.
System RAM: 8 to 64 Mbytes.
Video Memory: 1 Mbyte.
Cache Memory: 32 kbyte.
Persistence Data Map Memory: 16 bits per displayed pixel (64k levels).

3.18 Waveform Processing

Up to four processing functions may be performed simultaneously. Standard functions available are: Add, Subtract, Multiply, Divide, Negate, Identity, Summation Averaging and Sine x/x. The source information for a math function trace can be data from an acquisition channel or from another math function trace. This allows display of traces which "daisy chain" math functions.
Average: Up to 106 averages are possible.
Extrema*: Roof, Floor, or Envelope values from 1 to 106 sweeps.
ERES*: Six Low-Pass digital filters provide up to 11-bit vertical resolution. Sampled data is always available, even when a trace is turned off.
FFT*: Spectrum Analysis with five windowing functions and FFT averaging.

3.19 Statistical Diagnostics*:

The Parameter Analysis package permits in-depth diagnostics on waveform parameters. Live histogramming of any waveform parameter measurement is possible and the histogram can be autoscaled to display the center and width of the distribution.
Any of the above processes can be invoked without losing the data.

*Extrema and ERES modes are provided in the Advanced Waveform Math Package. FFT is in Spectrum Analysis. Histogramming is part of the Parameter Analysis Package.

3.20 Internal Memory

Waveform Memory: Up to four 16-bit Memories (M1, M2, M3, M4), whose length corresponds to the length of the channel acquisition memory.
Zoom & Math Memory: Up to four 16-bit Waveform Processing Memories (A, B, C, D), whose length corresponds to the length of the channel acquisition memory.
Setup Memory: Four non-volatile memories. Optional Memory Cards, Flash Disks or removable Hard Disks may also be used for high-capacity waveform and setup storage.

3.21 Cursor Measurements

Relative Time: Two cursors provide time measurements with resolution of ±0.05% full scale for unexpanded traces; up to 10% of the sampling interval for expanded traces. The corresponding frequency value is displayed.
Relative Voltage: Two horizontal bars measure voltage differences up to ±0.2%, of full scale in single-grid mode.
Absolute Time: A cross-hair marker measures time relative to the trigger and voltage with respect to ground.
Absolute Voltage: A reference bar measures voltage with respect to ground.

Automated Measurements

A wide range of pulse parameter measurements are available. These are categorized for ease of use. The categories include Pulse, Horizontal, and Vertical parameters. Basic statistical measurements, included as standard, (average, highest, lowest, and standard deviation) can be made on these parameter measurements in order to understand their distribution. Pass/Fail Testing and Waveform Limit testing using masks can be performed. Test conditions can be expressed as either waveform parameter limits, waveform shape limits (mask) or a combination of both. Any failure can cause preprogrammed actions such as Hardcopy, Save, GPIB service request, logic pulse out, audible beep, or any combination of the above.

3.22 Additional Information

Interfacing

Remote Control: Possible by GPIB and RS-232-C for all front-panel controls, as well as all internal functions.
RS-232-C Port: Asynchronous up to19.2 Kb/s for computer/terminal control or printer/plotter connection.
GPIB Port: (IEEE-488.1) Configurable as talker/listener for computer control and fast data transfer, up to 300 kbytes/sec. Command Language complies with requirements of IEEE-488.2.
Centronics Port: Hardcopy parallel interface is standard.
PC Card (PCMCIA I/II/III) Ports: For memory cards, ATA compatible flash cards and removable hard disks - optional.
Floppy Disk: High density 3.5" floppy disk drive (DOS format) is standard.
VGA Compatible Display: 15-pin D-type VGA compatible connector for external color display.
Hardcopy: Screen dumps are activated by a front-panel button or via remote control. TIFF and BMP formats are available for importing to Desktop Pub-lishing programs. The following printers can be used to make hardcopies:
B/W: HP LaserJet, HP DeskJet 500, Epson FX.
Color: HP DeskJet 550C, Epson Stylus. An optional internal high resolution graphics printer is also available for screen dumps; a stripchart output format with 2 meters per division is also possible.
Output Formats: ASCII waveform out-put is available in seconds, compatible with spread-sheets, MATLAB™, MathCad™. Binary output is also available.

General

Auto-calibration ensures specified DC and timing accuracy.
Temperature: 5° to 40°C (41° to 104° F) rated 0° to 50°C (32° to 122° F) operating.
Humidity: 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.
Altitude: Up to 2000m (operating), 40°C max.
Power: 90-132V AC, 180-250V AC, 45-66 Hz, 400 W.
Battery Backup: Front-panel settings maintained for two years.
Dimensions: (HWD)10.4" x 15.65" x 17.85", 264 mm x 397 mm x 453 mm.
Weight: 20kg (44 lbs) net, 28 kg (61.6 lbs) shipping.
Warranty: Three years.

CE Approval

EMC: Conforms to EN50081-1,EN50082.
Safety: The oscilloscope has been designed to comply with EN61010-1 Installation Category (Over-voltage Category) II, 300V, Pollution Degree 1.

4. Performance Verification Procedures

4.1 Introduction

This chapter contains procedures suitable for determining if the LC534/A Digital Storage Oscilloscope performs as warranted.
They check all the characteristics that are designated as specifications in subsection 4.1.1.

Because they require time and suitable test equipment, you may not need to perform all of these procedures, depending on what you want to accomplish.

In the absence of the computer automated calibration system based on LeCroy Calibration Software (LeCalsoft), this manual performance verification procedure can be followed to establish a traceable calibration.
It is the calibrating entities' responsibility to ensure that all laboratory standards used to perform this procedure are operating within their specifications and traceable to required standards if a traceable calibration certificate is to be issued for the LC534/A Digital Storage Oscilloscope.

4.1.1 List of Specifications

The electrical specifications described in terms of quantifiable performance limits are listed in this subsection.

- Input Impedance
- Leakage Current
- Peak to Peak and RMS Average noise level
- Positive and Negative DC linearity
- Positive and Negative Offset
- Bandwidth
- Trigger Level
- Smart Trigger
- Time Base Accuracy
- Overshoot and Rise Time
- Overload

4.1.2 Calibration Cycle

The LC534/A Digital Storage Oscilloscope requires periodic verification of performance. Under normal use (2,000 hours of use per year) and environmental conditions, this instrument should be calibrated once a year.

4.2 Test Equipment Required

These procedures use external, traceable signal generators, DC precision power supply, step generator and digital multimeter, to directly check specifications.

Instrument	Specifications	Recommended
Signal Generator Radio Frequency	Frequency : .5 MHz to 2 GHz Frequency Accuracy : 1 PPM	HP8648B or equivalent
Signal Generator Audio Frequency	Frequency : 0 to 5 kHz Amplitude : 8 V peak to peak	LeCroy LW420 or HP33120A or equivalent
Voltage Generator DC Power Supply	Range of 0 to 20 V, in steps of no more than 15 mV	HP6633A or equivalent
Step Generator Fast Pulser	Rise time 350ps ± 100 ps Overshoot 3.5 % ± 1 %	LeCroy 4969A + PB049 or equivalent
Power Meter + Sensor	Accuracy ±1 %	HP436A + 8482A or equivalent
Digital Multimeter Volt & Ohm	Voltmeter Accuracy : 0.1 % Ohmmeter Accuracy : 0.1 %	Keithley 2000 or equivalent
Adapter	50Ω to 1MΩ	LeCroy 4962-8
Adapter	2 GS/s, Single channel mode	LeCroy PP093
Coaxial Cable, 1 ns	50Ω, BNC, length 20 cm,	LeCroy 480232001
Coaxial Cable, 5 ns	50Ω, BNC, length 100 cm,	LeCroy 480020101
Attenuators, 20 dB	50Ω, BNC, 1 % accuracy, 2GHz	LeCroy 402200402
Terminator, 2 W	50Ω, BNC, Feed-Through	LeCroy 402323001
T adapter	50Ω, BNC T adapter	LeCroy 402222002

Table 4-1 : Test Equipment

4.2.1 Test Records

The last pages of this document contain LC534/A test records in the format tables. Keep them as masters and use a photocopy for each calibration.

4.3 Turn On

If you are not familiar with operating the LC534/A, read the operator's manual.

- Switch on the power using the power switch.

- Wait for about 10 minutes for the scope to reach a stable operating temperature, and verify :

* the display turns on after about 10 seconds and is stable.
* the range of intensity and grid intensity is reasonable.

4.4 Input Impedance

Specifications

DC 1.00 MΩ ±1 %
DC 50Ω ±1 %

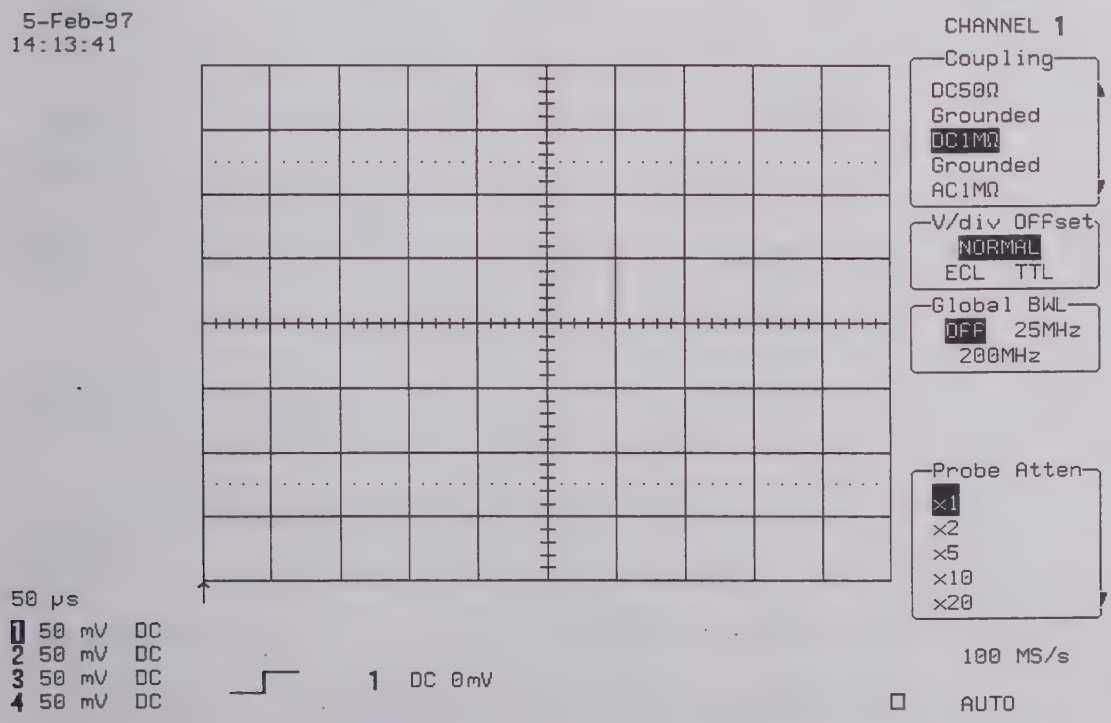
The impedance values for 50Ω, 1MΩ and Gnd couplings are measured with a high precision digital multimeter. The DMM is connected to the DSO in 4 wire configuration (input and sense), allowing for accurate measurements.

4.4.1 Channel Input Impedance

a. DC 1MΩ

- Recall **534P001.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace OFF		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 1MΩ** on all 4 Channels
Input gain	:	**50 mV/div.** on all 4 Channels
Time base	:	**50 µsec/div.**
Trigger mode	:	**Auto**

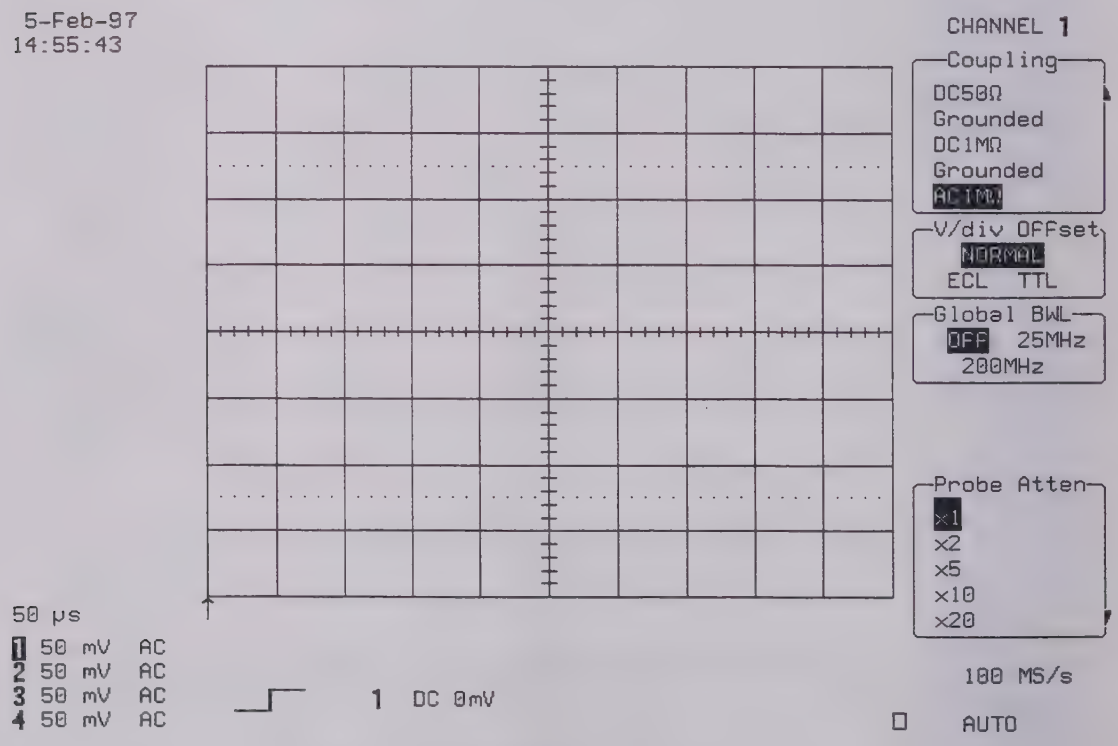


- Set the DMM with **Ohms and Ohms sense** to provide a 4 wire measurement.
- Connect it to Channel 1.
- Measure the **input impedance**. Record it in Table 2, and compare it to the limits.
- Repeat the above test for all input channels.
- Recall **534P002.PNL** or Set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the test results to the limits in the test record.

b. AC 1MΩ

- Recall **534P003.PNL** or configure the DSO as shown in 4.4.1.a, and for each Channel make the following change :

  Input Coupling : **AC 1MΩ**



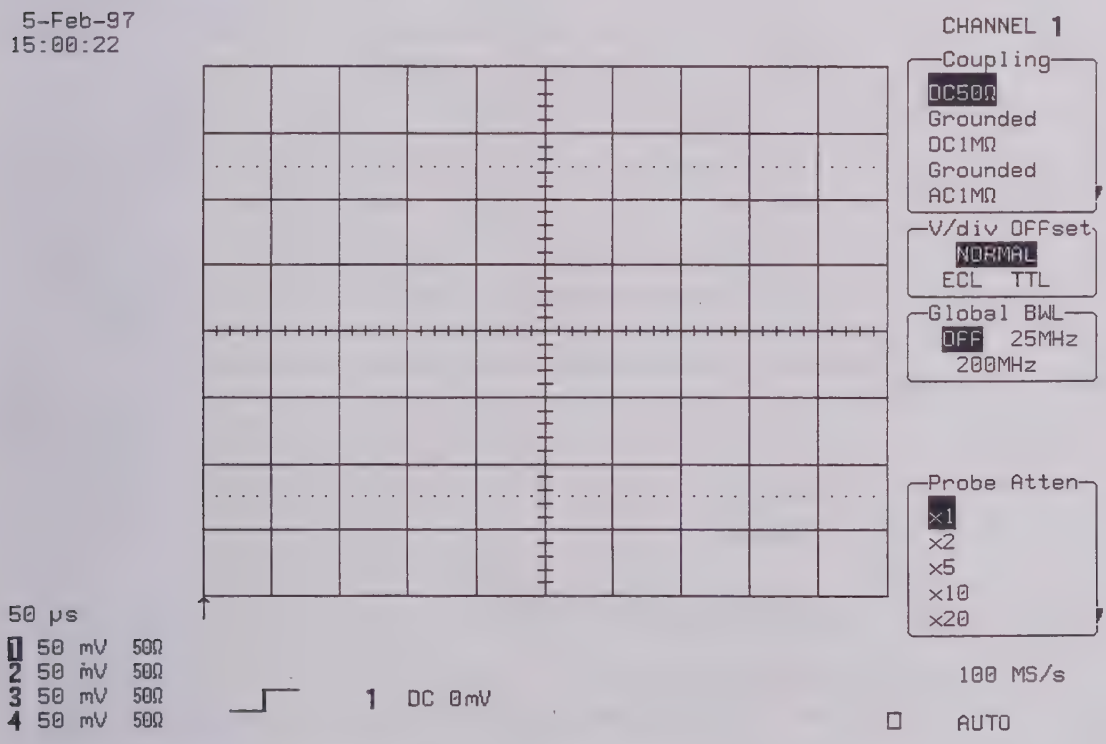
- For all input channels measure the **input impedance**.

- Record the input impedance in Table 2, and compare it to the limits.
- Recall **534P004.PNL** or Set Input gain to **200 mV/div** on all 4 Channels.
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the results to the limits in the test record.

c. DC 50Ω

- Recall **534P005.PNL** or configure the DSO as shown in 4.4.1.a, and for each Channel make the following change:

  Input Coupling : **DC 50Ω**



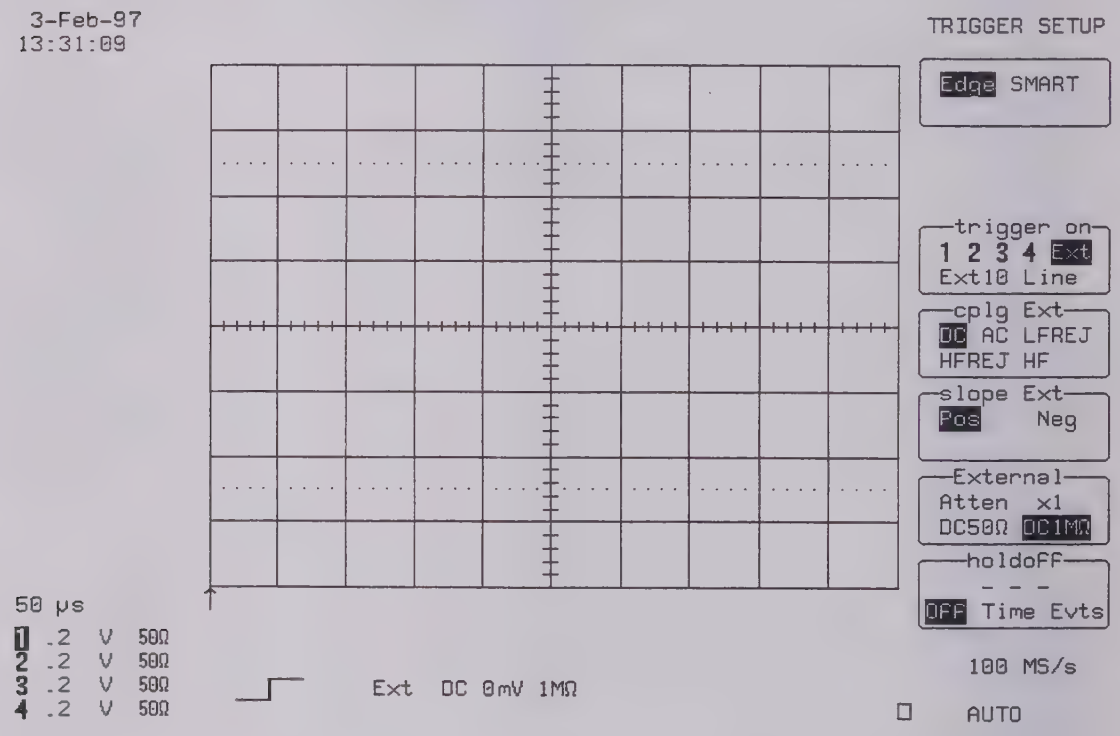
- For all input Channels, measure the input impedance.
- Record the **input impedance** in Table 2, and compare it to the limits.
- Recall **534P006.PNL** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 2, and compare the results to the limits in the test record.

4.4.2 External Trigger Input Impedance

a. DC 1MΩ

- Recall **534P007.PNL** or configure the DSO :

Set Trigger on	:	**EXT**
Trigger mode	:	**Auto**
Cplg Ext	:	**DC**
External	:	**DC 1MΩ**
Time base	:	**50 μsec/div.**



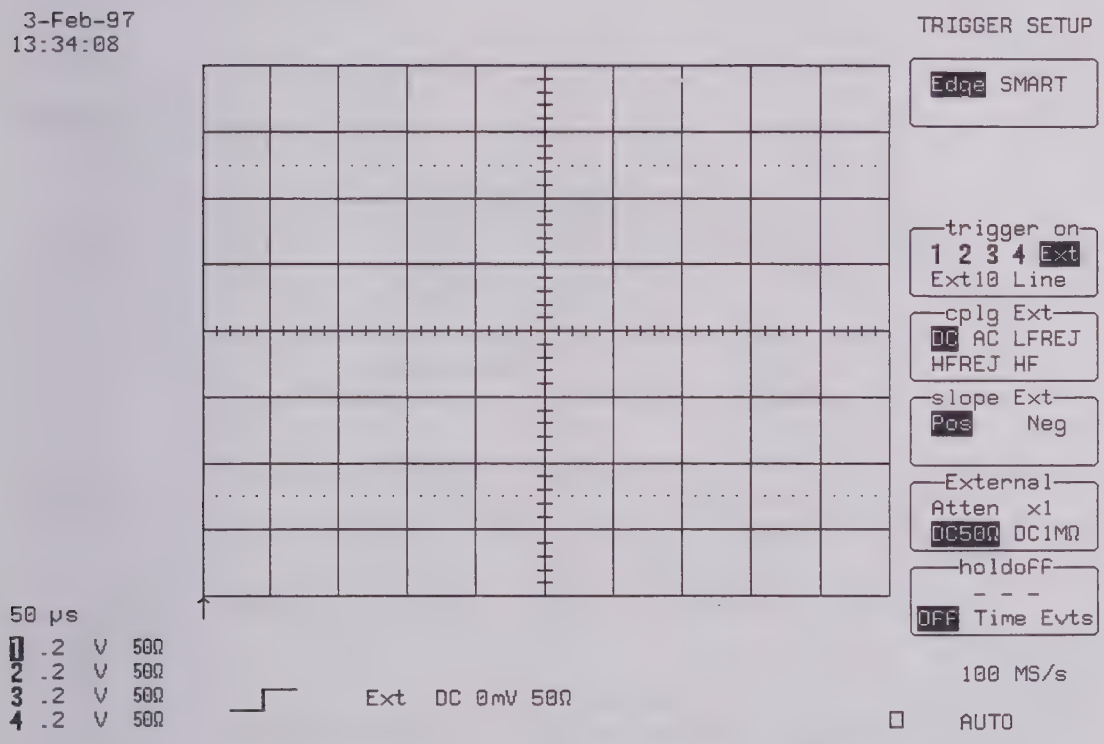
- Connect the DMM to External, and measure the **input impedance**.
- Record the input impedance in Table 2, and compare it to the limits.
- Recall **534P008.PNL** or set trigger to Ext/10
- Measure the **input impedance**.
- Record the test result in Table 2, and compare the result to the limits in the test record.

b. DC 50Ω

- Recall **534P009.PNL** or configure the DSO :

  Trigger on : **EXT**

  External : **DC 50Ω**

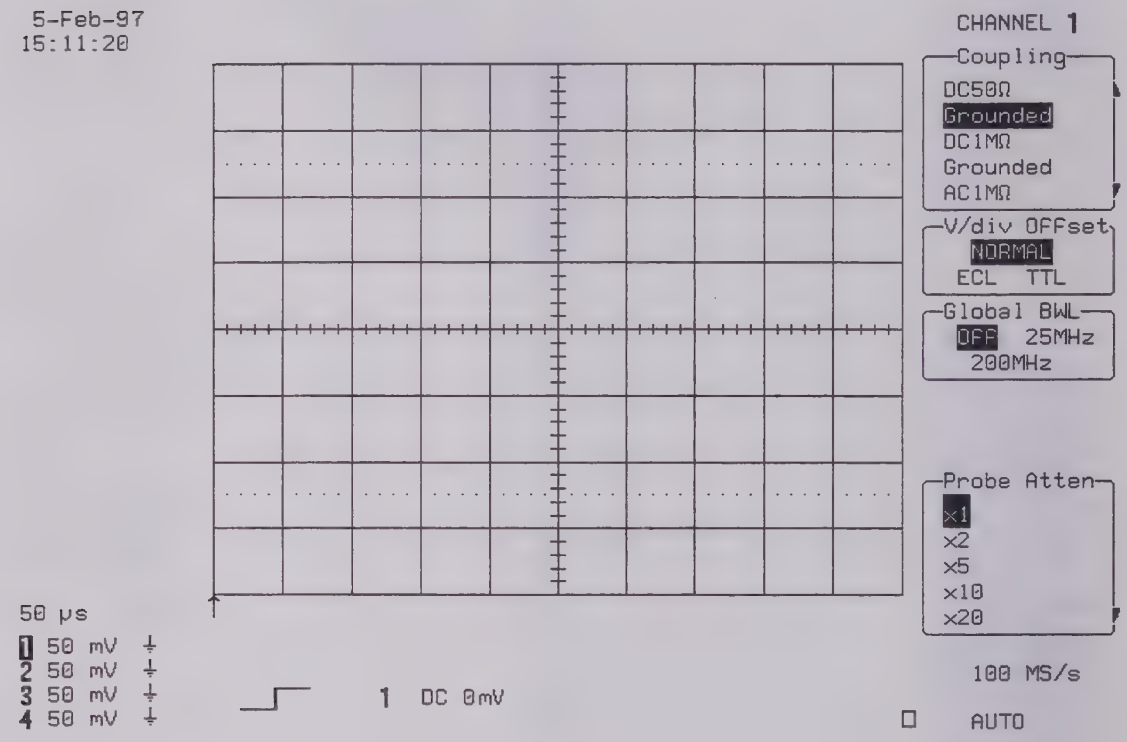


- Connect the DMM to External, and measure the **input impedance**.
- Record the input impedance in Table 2, and compare the result to the limit in the test record.

4.4.3 Ground

- Recall **534P010.PNL** or configure the DSO as shown in 4.4.1.a, and for each Channel make the following changes :

  Input Coupling : **Grounded**



- Connect the DMM to Channel 1, and measure the **input impedance.**
- Record the input impedance in Table 2, and compare the result to the limit in the test record.
- Repeat the test for all input channels.
- Record the measurements in Table 2, and compare the results to the limits in the test record.

4.5 Leakage Current

Specifications

DC 1MΩ, AC 1MΩ, DC 50Ω : ±1 mV

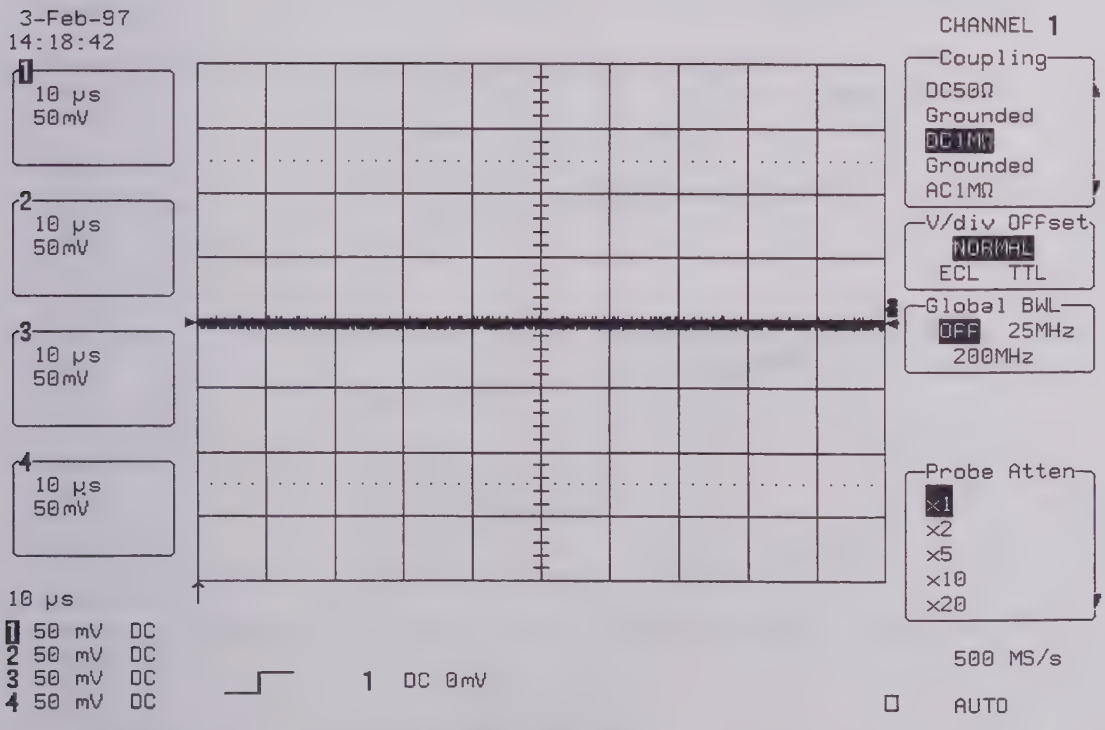
The leakage current is tested by measuring the voltage across the input channel.

4.5.1 Channel Leakage Current

a. DC 1MΩ

- Recall **534P011.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 1MΩ** on all 4 Channels
Input gain	:	**50 mV/div.** on all 4 Channels
Trigger mode	:	**Auto**
Time base	:	**10 µsec/div.**



- Set the DMM to measure Volts, and connect it to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.

- Repeat the test for all input channels.
- Recall **534P012.PNL** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.

b. DC 50Ω

- Recall **534P013.PNL** or configure the DSO as shown in 4.5.1.a and for each Channel make the following changes :

  Set Input Coupling: **DC 50Ω**

- Connect the DMM to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.
- Recall **534P014.PNL** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels.
- Record the measurements in Table 3, and compare the results to the limits in the test record.

4.5.2 External Trigger Leakage Current

a. DC 50Ω

- Recall **534P015.PNL** or configure the DSO as shown in 4.5.1.a and make the following changes :

  Set Trigger on : **EXT**

  External : **DC 50Ω**

- Connect the DMM to External.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.

4.6 Average Noise Level

Description

Noise tests with open inputs are executed on all channels for both 1MΩ and 50Ω input impedance, with AC and DC input coupling, 0 mV offset, at again setting of 10 mV/div., and different timebase settings.
The scope parameters functions are used to measure the Peak and RMS amplitude of the noise.

4.6.1 Peak to Peak Noise

Specifications

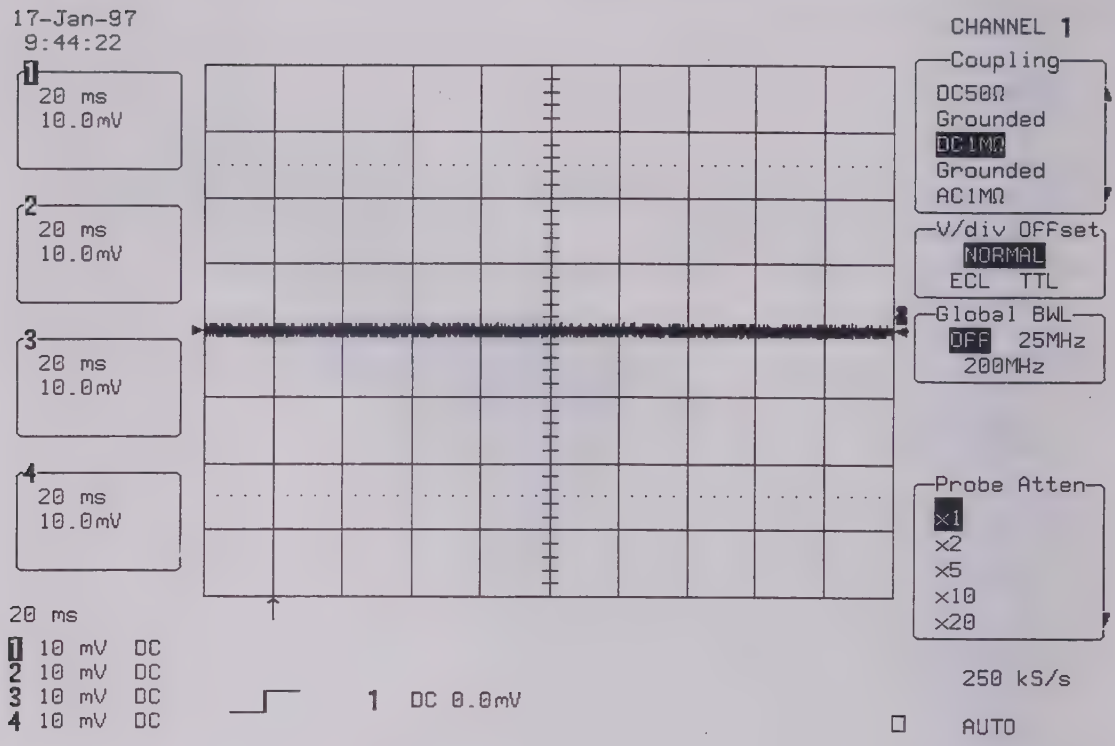
9 % of full scale or 7.2 mV Peak Peak at 10 mV/div.

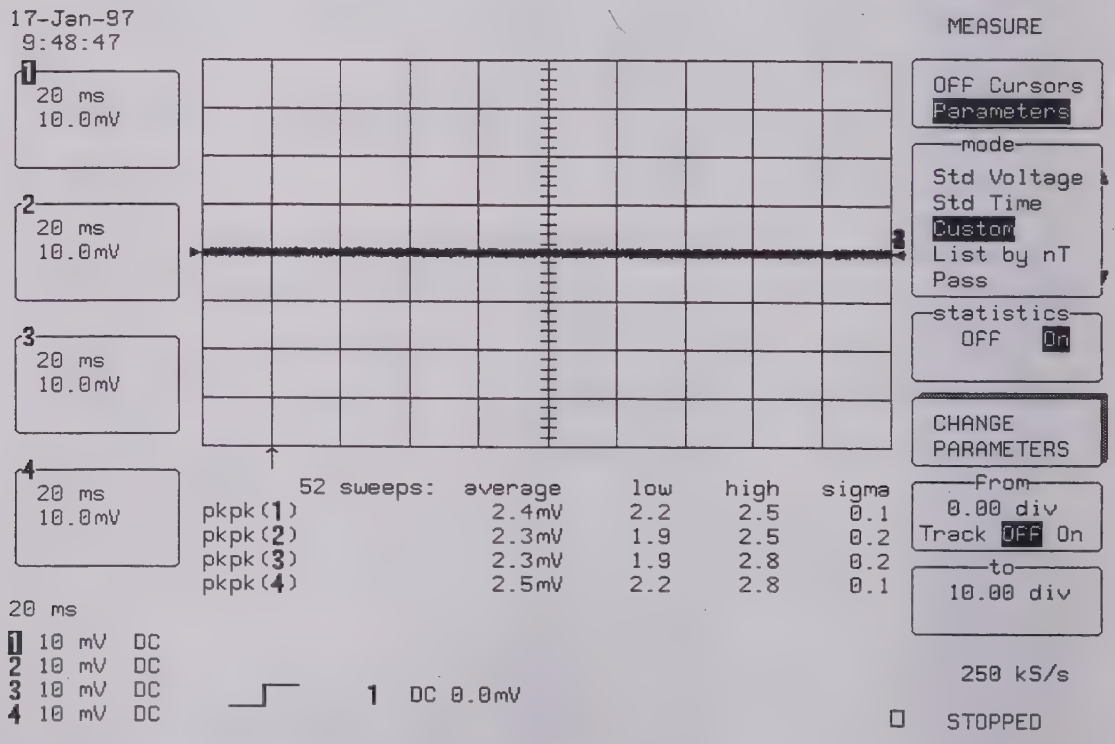
a. DC 1MΩ

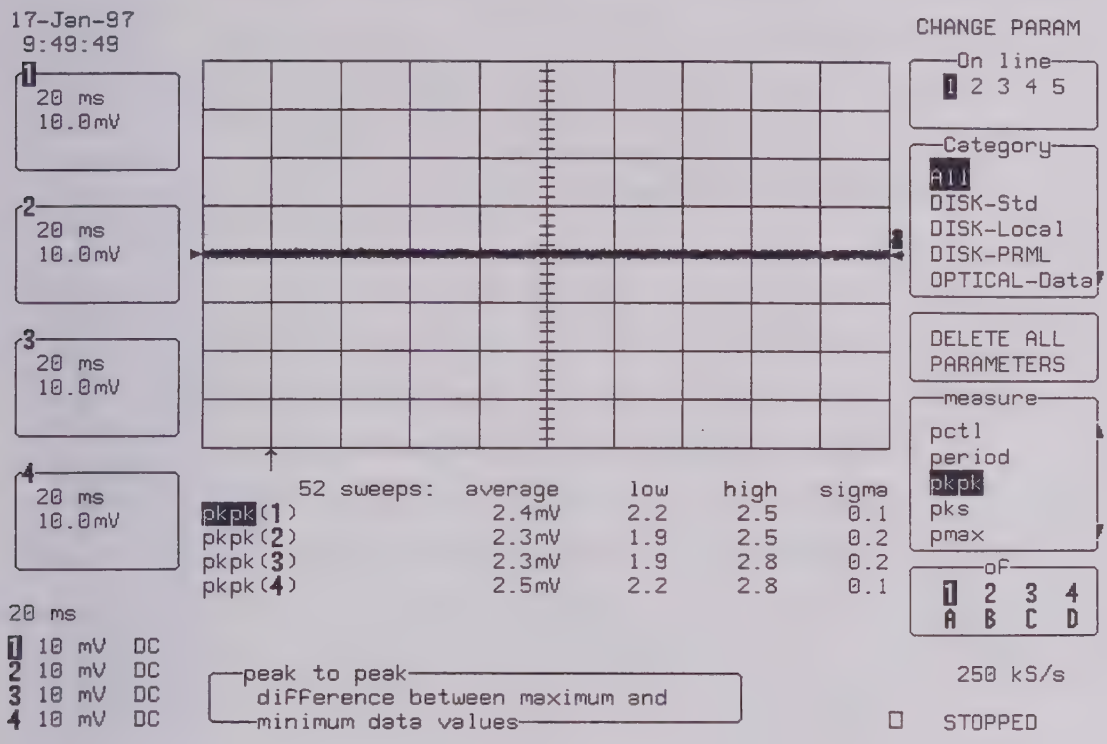
With no signal connected to the inputs

- Recall **534P016.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 1MΩ** on all 4 Channels
Input gain	:	**10 mV/div.** on all 4 Channels
Input offset	:	**0.0 mV** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**1**
Coupling 1	:	**DC**
Trigger Mode	:	**Auto**
Timebase	:	**20 msec/div.**
Channel use	:	**4**
Record up to	:	**50 k Samples**
Press	:	**Cursors/Measure**
Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**On**
Change parameters		
Category	:	**All**
On line 1	:	**Measure pkpk of Ch1**
On line 2	:	**Measure pkpk of Ch2**
On line 3	:	**Measure pkpk of Ch3**
On line 4	:	**Measure pkpk of Ch4**
On line 5	:	**no parameter selected for line 5**


17-Jan-97
9:44:22
1
20 ms
10.0mV
2
20 ms
10.0mV
3
20 ms
10.0mV
4
20 ms
10.0mV
CHANNEL 1
Coupling
DC50Ω
Grounded
DC1MΩ
Grounded
AC1MΩ
V/div OFFset
NORMAL
ECL TTL
Global BWL
OFF 25MHz
200MHz
Probe Atten
x1
x2
x5
x10
x20
20 ms
1 10 mV DC
2 10 mV DC
3 10 mV DC
4 10 mV DC
1 DC 0.0mV
250 kS/s
AUTO


17-Jan-97
9:48:47
1
20 ms
10.0mV
2
20 ms
10.0mV
3
20 ms
10.0mV
4
20 ms
10.0mV
MEASURE
OFF Cursors
Parameters
mode
Std Voltage
Std Time
Custom
List by nT
Pass
statistics
OFF On
CHANGE
PARAMETERS
From
0.00 div
Track OFF On
to
10.00 div
52 sweeps: average low high sigma
pkpk(1) 2.4mV 2.2 2.5 0.1
pkpk(2) 2.3mV 1.9 2.5 0.2
pkpk(3) 2.3mV 1.9 2.8 0.2
pkpk(4) 2.5mV 2.2 2.8 0.1
20 ms
1 10 mV DC
2 10 mV DC
3 10 mV DC
4 10 mV DC
1 DC 0.0mV
250 kS/s
STOPPED



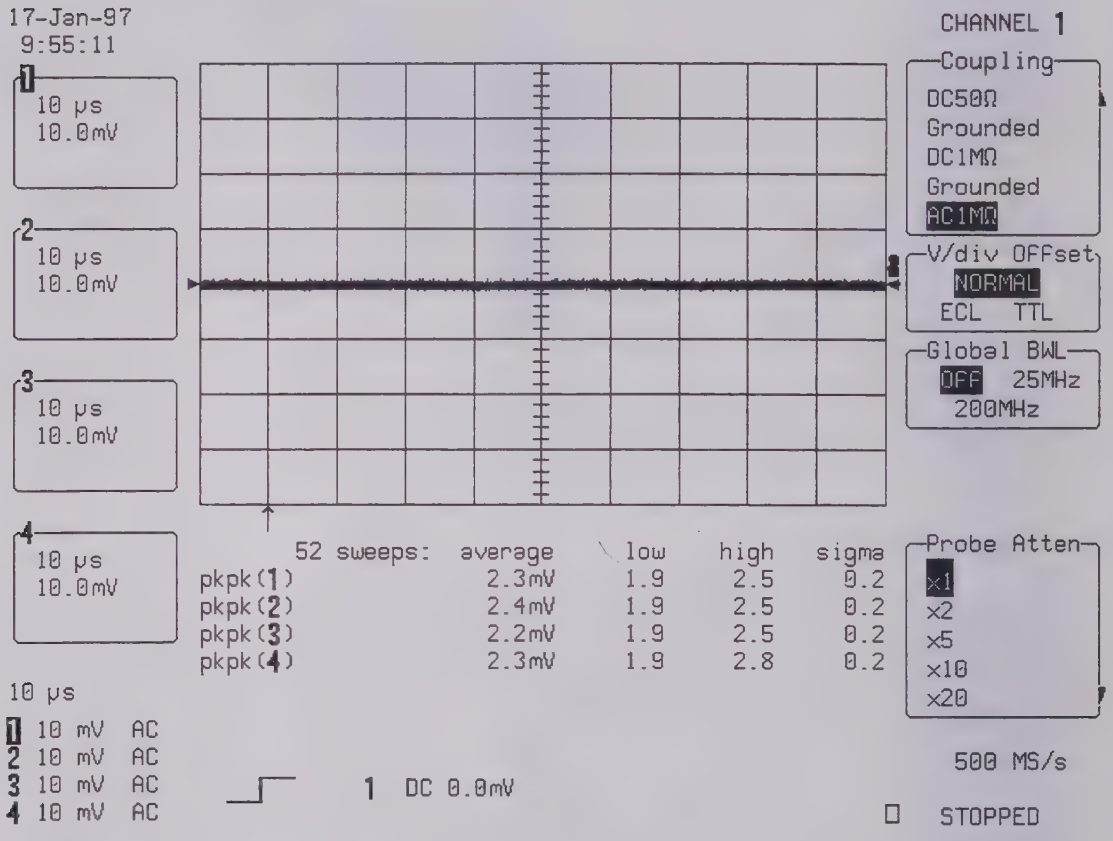
- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.
- Repeat the test for Timebase : **1 msec/div.**, **50 μsec/div.**, and **10 μsec/div.**
- Record the measurements (high pkpk of 1,2,3,4) in Table 4, and compare the results to the limits in the test record.

b. AC 1MΩ

- Recall **534P017.PNL** or configure the DSO as shown in 4.6.1.a, and for each Channel make the following changes :

  Input Coupling : **AC 1MΩ**

- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.



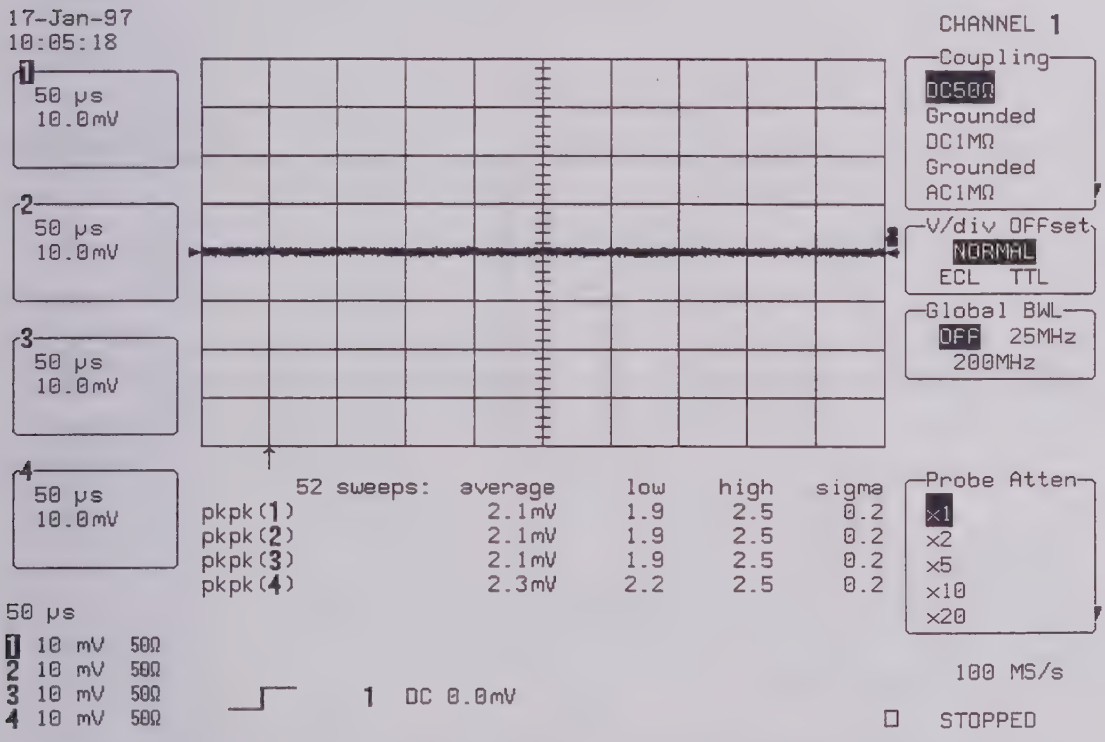
c. DC 50Ω

- Recall **534P018.PNL** or configure the DSO as shown in 4.6.1.a, and for each Channel make the following changes :

  Input Coupling : **DC 50Ω**

- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.

- Record the four **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.
- Repeat the test for Timebase : **50 μsec/div.**
- Record the measurements (high pkpk of 1,2,3,4) in Table 4, and compare the results to the limits in the test record.



d. DC 50Ω, 2 Channel Mode

- Recall **534P019.PNL** or configure the DSO as shown in 4.6.1.a. and make the following changes :

Input Coupling : **DC 50Ω** on all 4 Channels

Input gain : **10 mV/div.** on all 4 Channels

Timebase : **5 μsec/div.**

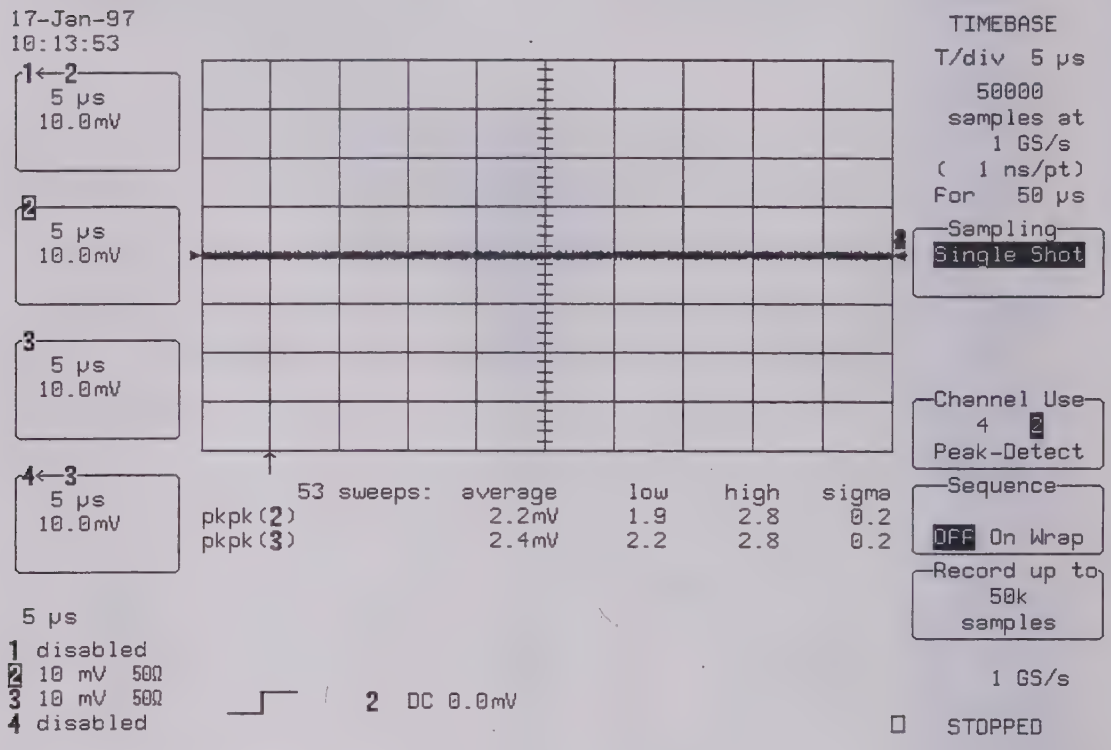
Select **Setup Timebase**

Channel use : **2**

Change parameters

On line 1 : **Measure pkpk of Ch2**

On line 2 : **Measure pkpk of Ch3**



- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the two **high pkpk** parameter values in Table 4, and compare the test results to the limits in the test record.

e. DC 50Ω, All Channels Combined

- Recall **534P020.PNL** or configure the DSO as shown in 4.6.1.a. and make the following changes :

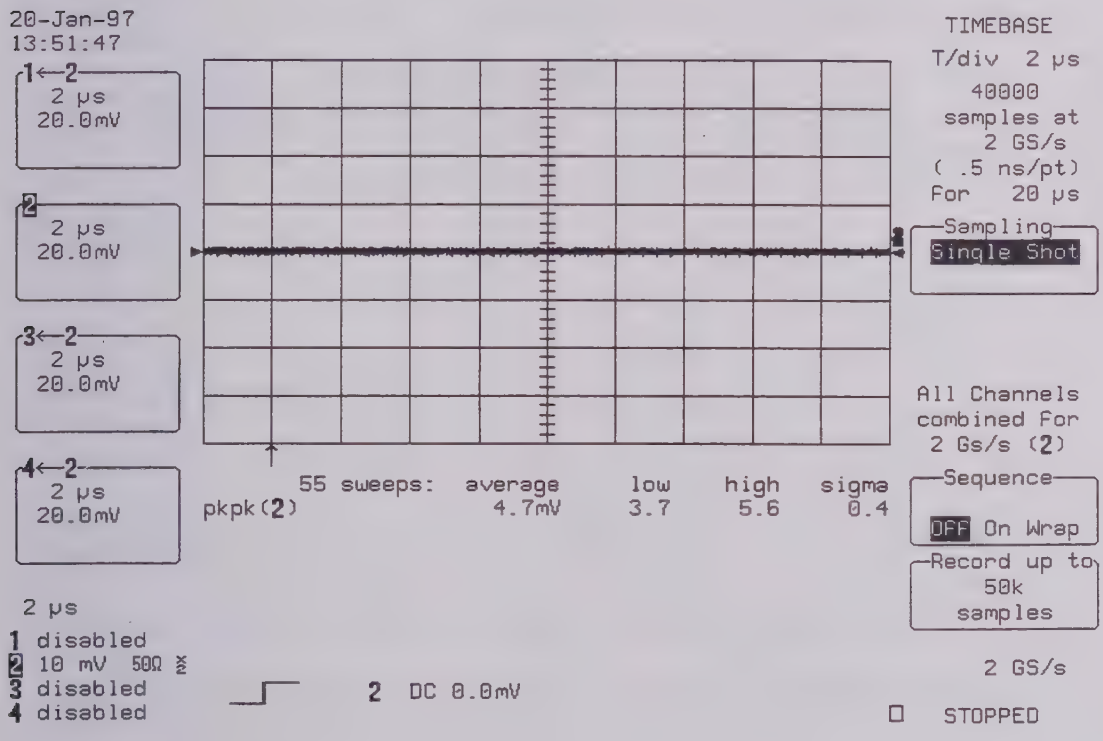
Input Coupling : **DC 50Ω** on all 4 Channels

Timebase : **2 µsec/div.**

Change parameters

On line 1 : **Measure pkpk of Ch2**

- Connect a **PP093** adapter to Channel 2 and Channel 3
- Check :
- PP093 is identified on **Channel 2.**
- Channel 1, Channel 3 and Channel 4 are **disabled**
- Sampling rate is **2 GS/s**



- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the **high pkpk** parameter value in Table 4, and compare the test result to the limits in the test record.
- Disconnect the **PP093** adapter.

4.6.2 Rms Noise

Specifications

0.9 % of full scale or 0.72 mV at 10 mV/div.

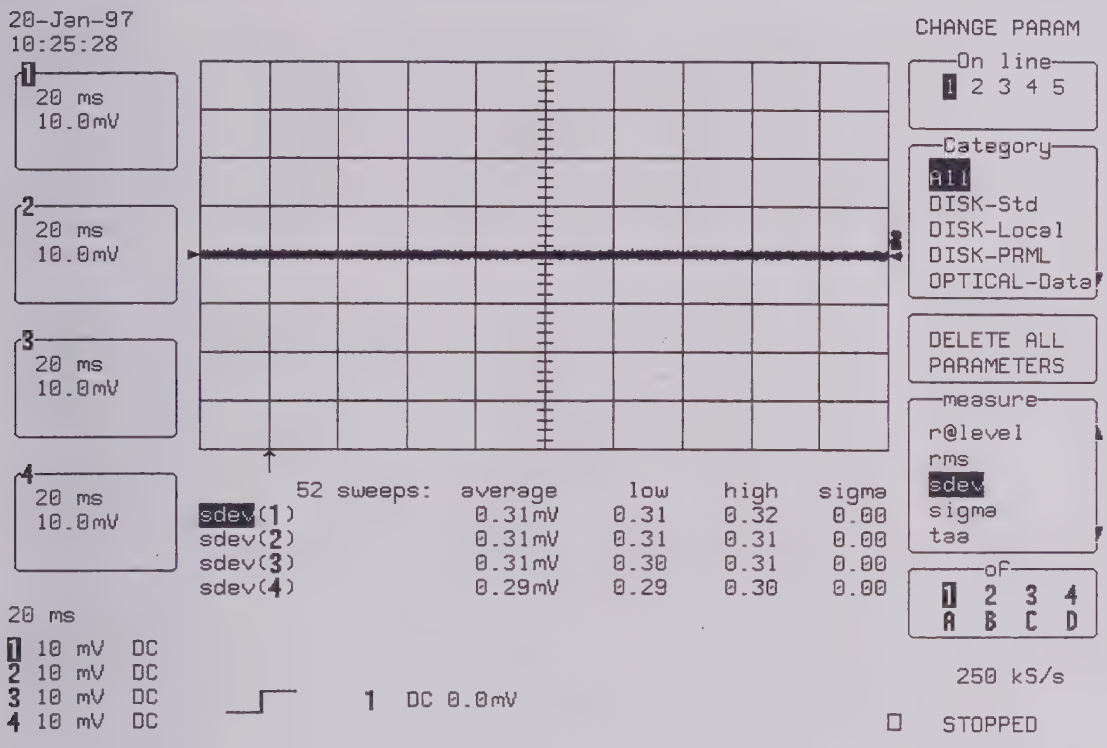
a. DC 1MΩ

Procedure

With no signal connected to the inputs

- Recall **534P021.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 1MΩ** on all 4 Channels
Input gain	:	**10 mV/div.** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**1**
Coupling 1	:	**DC**
Trigger Mode	:	**Auto**
Timebase	:	**20 msec/div.**
Channel use	:	**4**
Record up to	:	**50 k Samples**
Press	:	**Cursors/Measure**
Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**On**
Change parameters		
Category	:	**All**
On line 1	:	**Measure sdev of Ch1**
On line 2	:	**Measure sdev of Ch2**
On line 3	:	**Measure sdev of Ch3**
On line 4	:	**Measure sdev of Ch4**
On line 5	:	**no parameter selected for line 5**



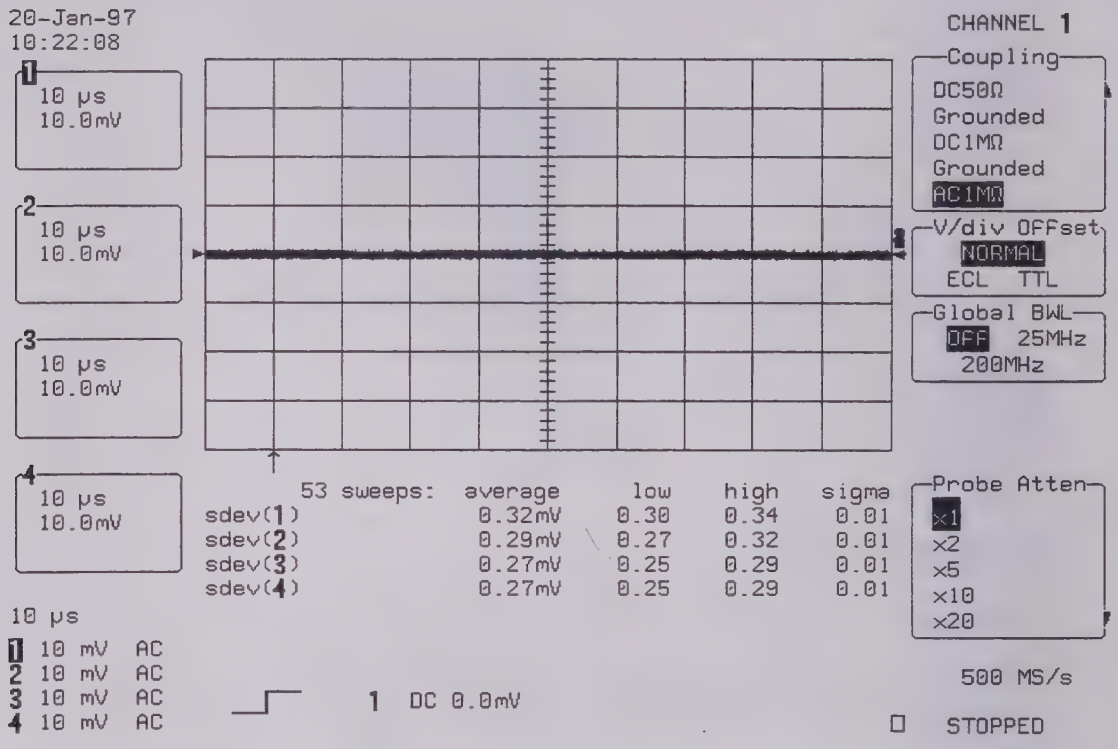
- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.
- Repeat the test for Timebase : **1 msec/div.**, **50 µsec/div.**, and **10 µsec/div.**
- Record the measurements (high sdev of 1,2,3,4) in Table 5, and compare the results to the limits in the test record.

b. AC 1MΩ

- Recall **534P022.PNL** or configure the DSO as shown in 4.6.2.a. and for each Channel make the following change :

  Input Coupling : **AC 1MΩ**

- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the four **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.



c. DC 50Ω

- Recall **534P023.PNL** or configure the DSO as shown in 4.6.2.a and make the following changes :

  Input Coupling : **DC 50Ω** on all 4 Channels

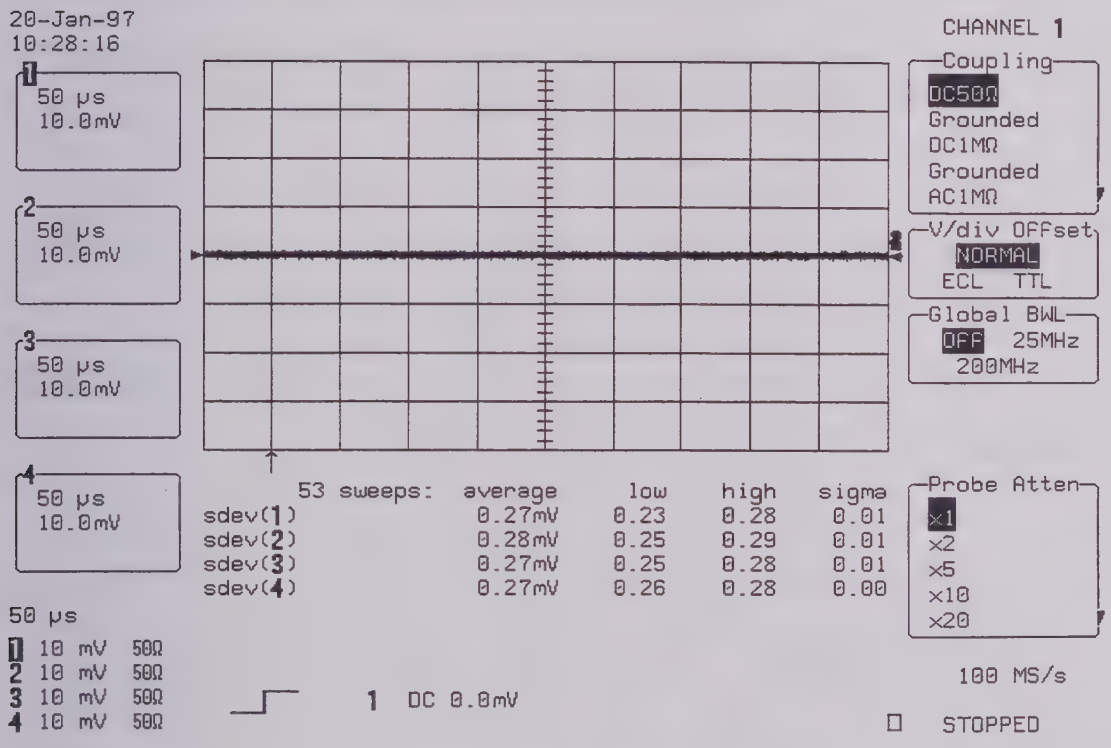
  Timebase : **10 µsec/div.**

- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.

- Record the four **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.

- Repeat the test for Timebase : **50 μsec/div.**

- Record the measurements (high sdev of 1,2,3,4) in Table 5, and compare the results to the limits in the test record.



d. DC 50Ω, 2 Channel Mode

- Recall **534P024.PNL** or configure the DSO as shown in 4.6.2.a and make the following changes :

  Input Coupling : **DC 50Ω** on all 4 Channels

  Timebase : **5 μsec/div.**

  Select **Setup Timebase**

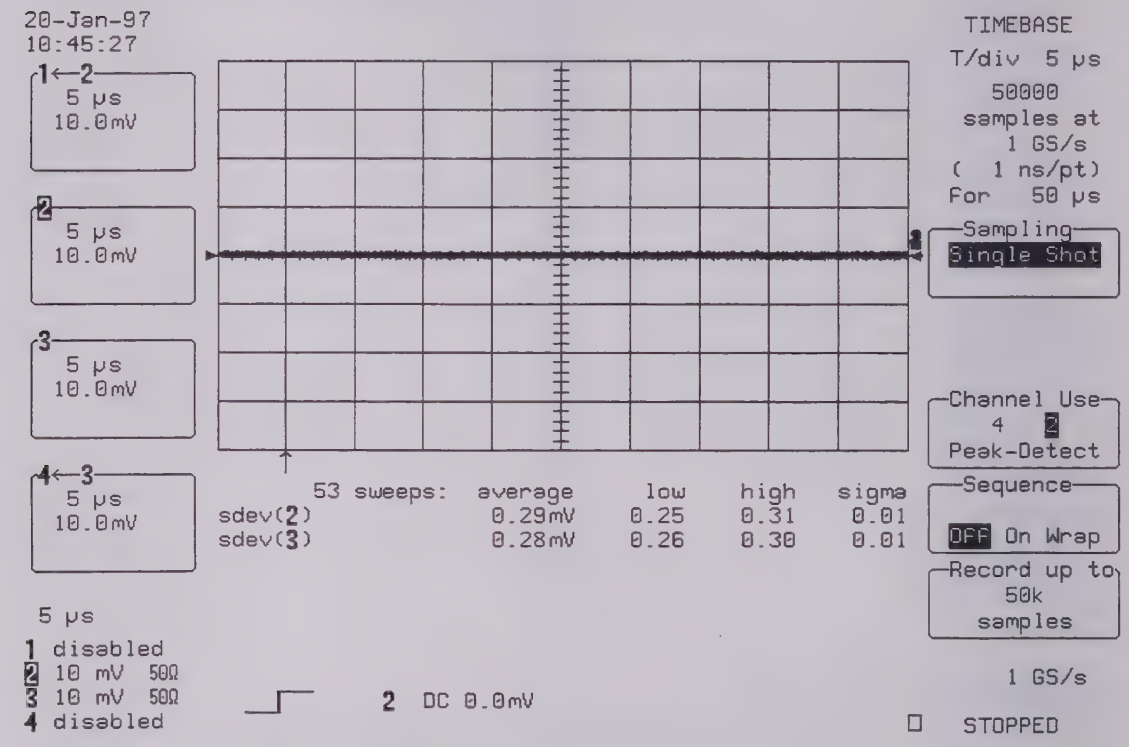
  Channel use : **2**

Change parameters

On line 1 : **Measure sdev of Ch2**

On line 2 : **Measure sdev of Ch3**

- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the two **high sdev** parameter values in Table 5, and compare the test results to the limits in the test record.



e. DC 50Ω, All Channels Combined

- Recall **534P025.PNL** or configure the DSO as shown in 4.6.2.a and make the following changes :

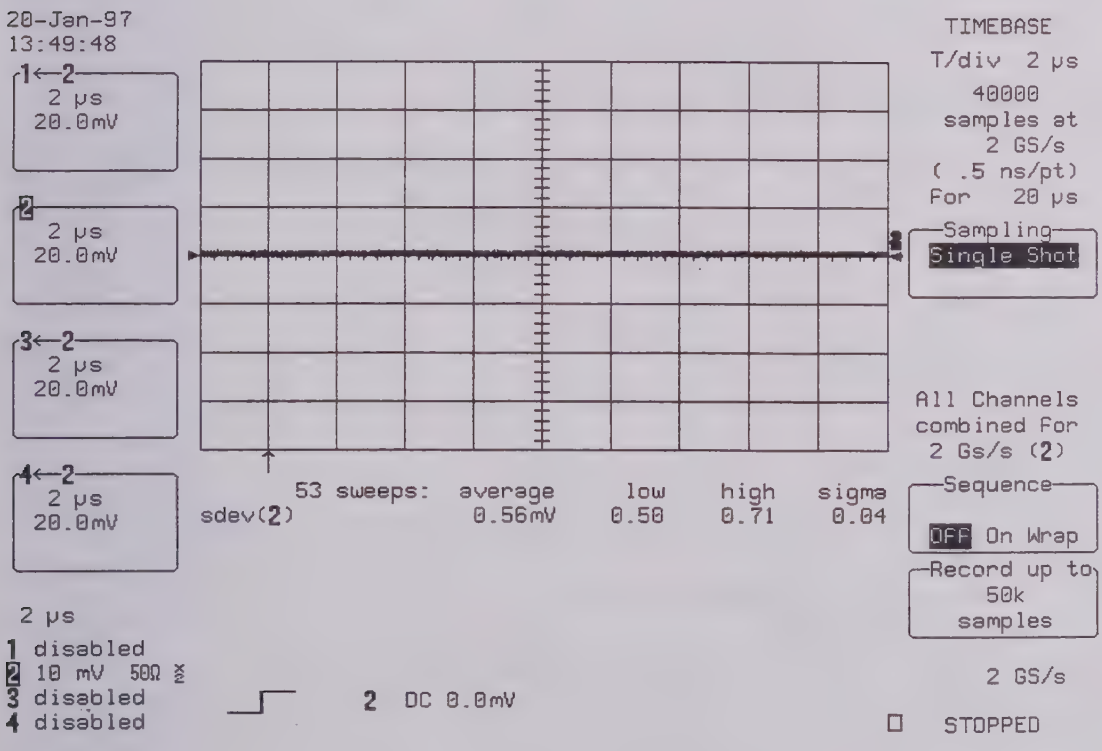
Input Coupling : **DC 50Ω** on all 4 Channels

Timebase : **2 µsec/div.**

Change parameters

On line 1 : **Measure sdev of Ch2**

- Connect a **PP093** adapter to Channel 2 and Channel 3
- Check :
- PP093 is identified on **Channel 2**
- Channel 1, Channel 3 and Channel 4 are **disabled**
- Sampling rate is **2 GS/s**



- Press **Clear Sweeps.**
- Measure for at least **50 sweeps**, then press **Stop** to halt the acquisition.
- Record the **high sdev** parameter value in Table 5, and compare the test result to the limits in the test record.
- Disconnect the **PP093** adapter.

4.6.3 Ground Line Test

Specifications

±5 % of full scale at 5 mV/div.
±2 % of full scale at 10 mV/div. and above.

Procedure

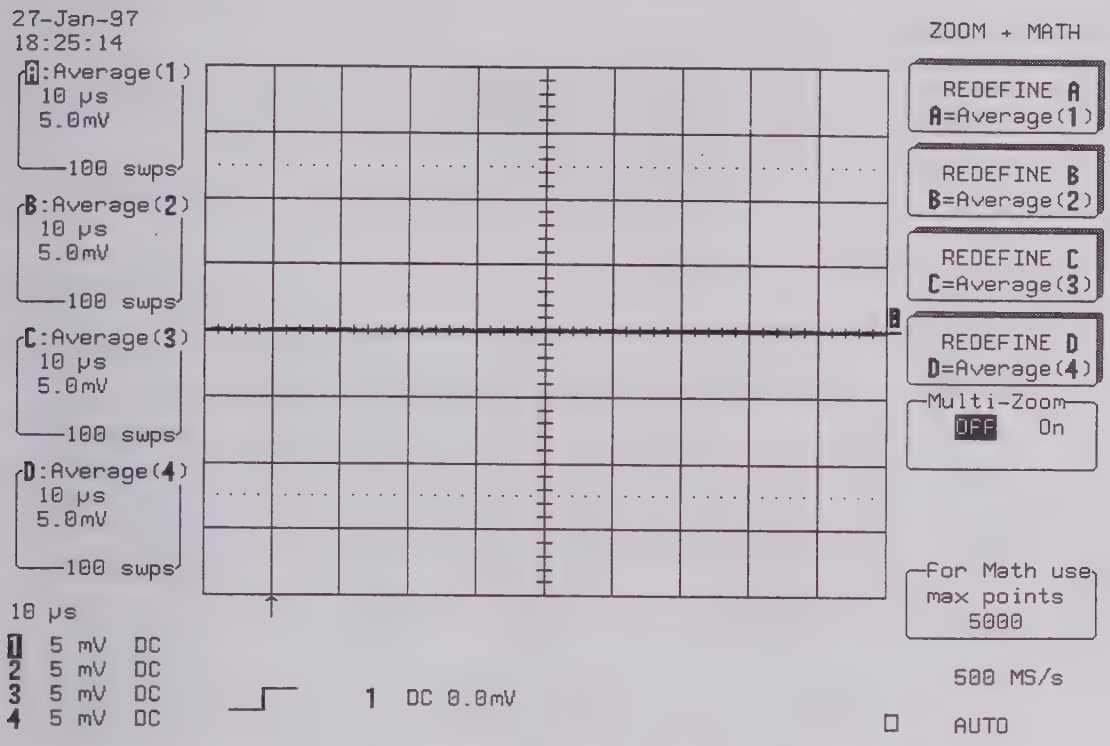
The stability of the ground line is verified for each channel at each fixed gain. The measured average values are checked against the desired limits.

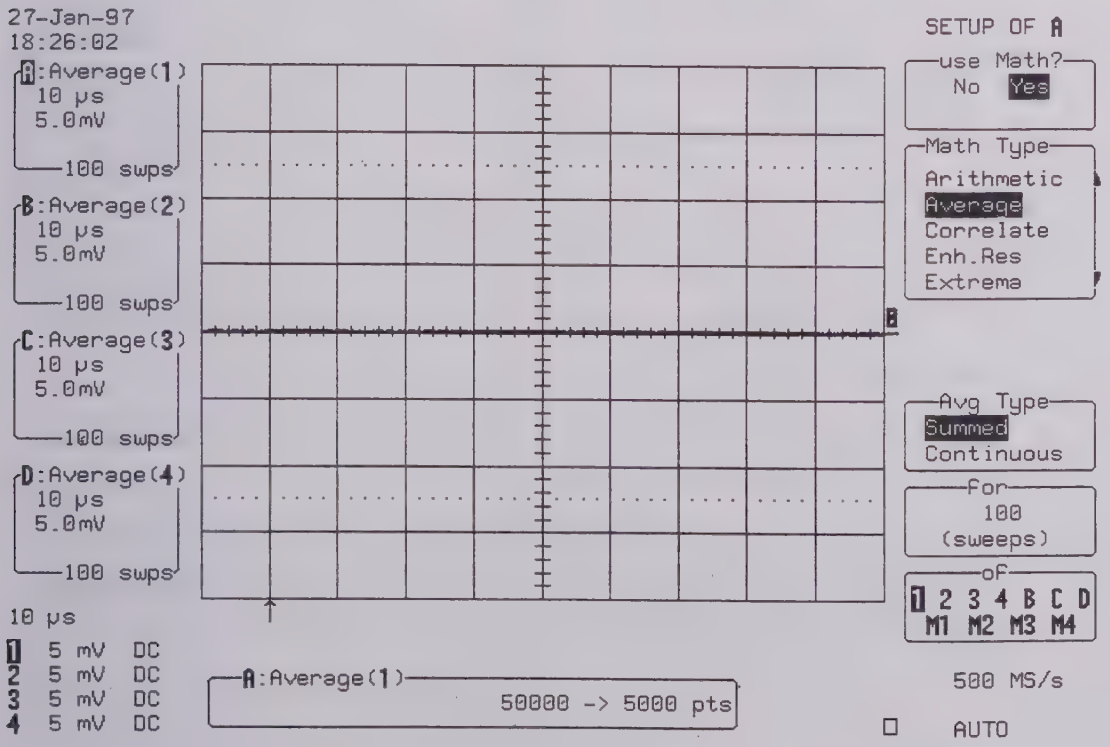
a. DC 1MΩ

With no signal connected to the inputs

- Recall **534P026.PNL** or configure the DSO :

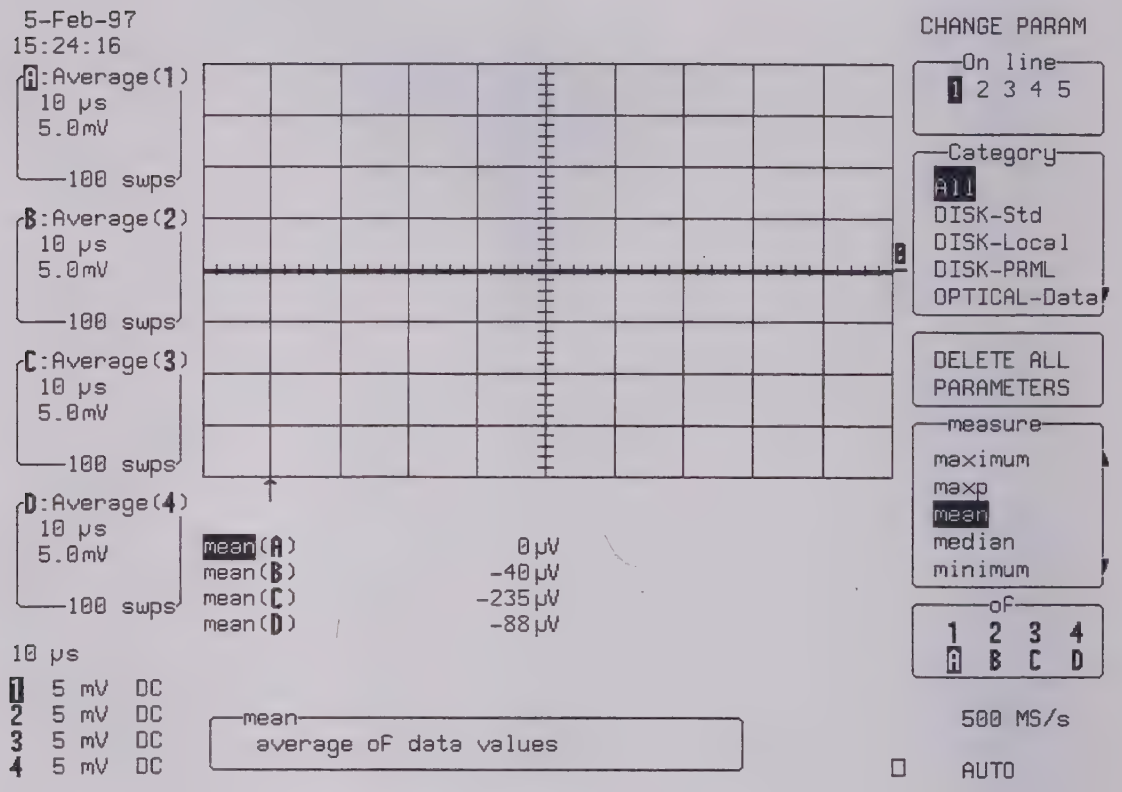
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 1MΩ** on all 4 Channels
Input gain	:	**5 mV/div.** on all 4 Channels
Offset	:	**Zero** on all 4 Channels
Trigger on	:	**Channel 1, DC**
Trigger mode	:	**Auto**
Timebase	:	**10 µsec/div.**
Channel use	:	**4**
Record up	:	**50 k**
Channels Trace OFF		**Channel 1, Channel 2, Channel 3 & Channel 4**
Zoom+Math Trace ON		**A, B, C & D**
Select Math Setup		
For Math	:	**Use at most 5000 points**
Redefine A, B, C, D		**Channel 1, Channel 2, Channel 3 & Channel 4**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg. Type	:	**Summed**
For	:	**100 sweeps**
Press Cursors/Measure		
Select	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**off**


27-Jan-97
18:25:14
A:Average(1)
10 µs
5.0mV
100 swps
B:Average(2)
10 µs
5.0mV
100 swps
C:Average(3)
10 µs
5.0mV
100 swps
D:Average(4)
10 µs
5.0mV
100 swps
10 µs
1 5 mV DC
2 5 mV DC
3 5 mV DC
4 5 mV DC
1 DC 0.0mV
ZOOM + MATH
REDEFINE A
A=Average(1)
REDEFINE B
B=Average(2)
REDEFINE C
C=Average(3)
REDEFINE D
D=Average(4)
Multi-Zoom
OFF On
For Math use
max points
5000
500 MS/s
AUTO


27-Jan-97
18:26:02
A:Average(1)
10 µs
5.0mV
100 swps
B:Average(2)
10 µs
5.0mV
100 swps
C:Average(3)
10 µs
5.0mV
100 swps
D:Average(4)
10 µs
5.0mV
100 swps
10 µs
1 5 mV DC
2 5 mV DC
3 5 mV DC
4 5 mV DC
A:Average(1)
50000 -> 5000 pts
SETUP OF A
use Math?
No Yes
Math Type
Arithmetic
Average
Correlate
Enh.Res
Extrema
Avg Type
Summed
Continuous
For
100
(sweeps)
of
1 2 3 4 B C D
M1 M2 M3 M4
500 MS/s
AUTO

Change parameters

On line 1	:	**Measure mean of A**
On line 2	:	**Measure mean of B**
On line 3	:	**Measure mean of C**
On line 4	:	**Measure mean of D**

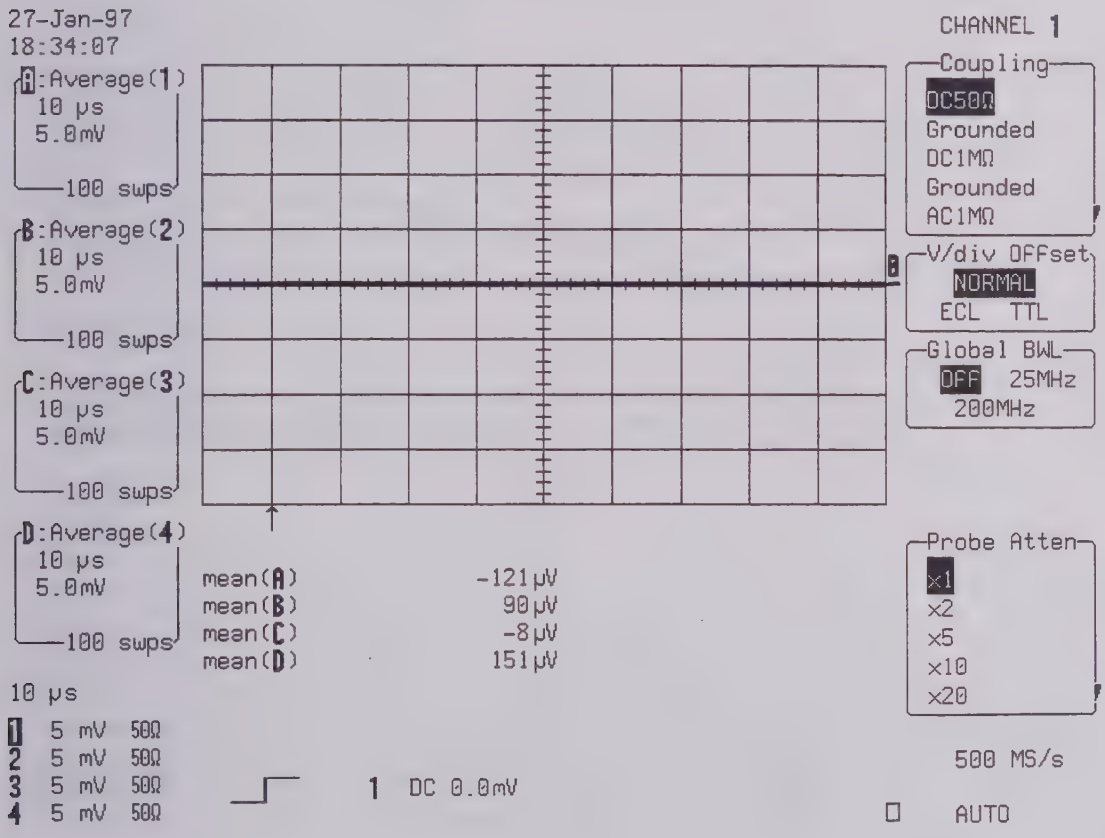


- Press **Clear Sweeps.**
- After **100 sweeps** record the **mean** value of **A, B, C & D** in Table 6, and compare the test results to the limits in the test record.
- Repeat step 4.6.3.a. for all vertical scale settings listed in Table 6, and check that the test results (mean value of A, B, C, D) are within the limits specified.
- Record the measurements in Table 6.

b. DC 50Ω

- Recall **534P027.PNL** or configure the DSO as shown in 4.6.3.a. and for each Channel make the following change :

  Input Coupling : **DC 50Ω**



- Press **Clear Sweeps.**
- After **100 sweeps** record the **mean** value of **A, B, C & D** in Table 7, and compare the test results to the limits in the test record.
- Repeat step 4.6.3.b. for all vertical scale settings listed in Table 7, and check that the test results (mean value of A, B, C, D) are within the limits specified.
- Record the measurements in Table 7.

c. DC 50Ω, 2 Channel Mode

- Recall **534P028.PNL** or configure the DSO as shown in 4.6.3.a. and make the following change :

  Input Coupling : **DC 50Ω** on all 4 Channels
  Input gain : **0.2 V/div.** on all 4 Channels
  Timebase : **5 µsec/div.**

  Select **Setup Timebase**

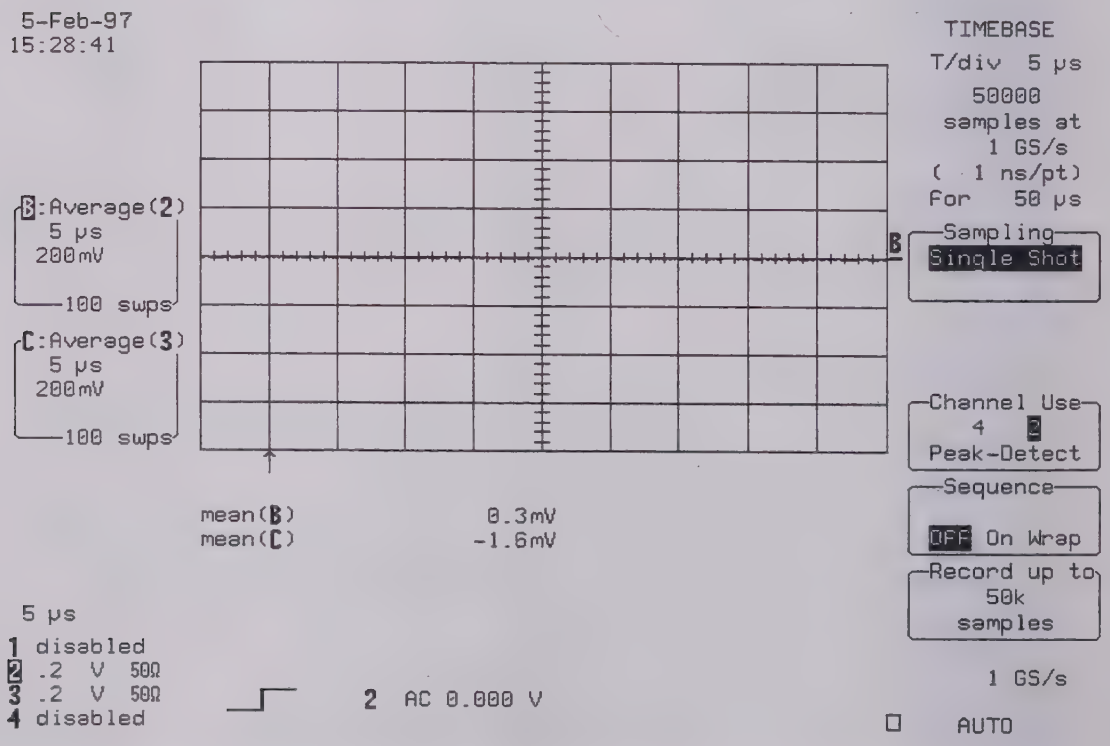
  Channel use : **2**

  Change parameters

  On line 1 : **Mean of B**
  On line 2 : **Mean of C**

- Press **Clear Sweeps.**

- After **100 sweeps** record the **mean** value of **B & C** in Table 7, and compare the test results to the limits in the test record.



d. DC 50Ω, All Channel Combined

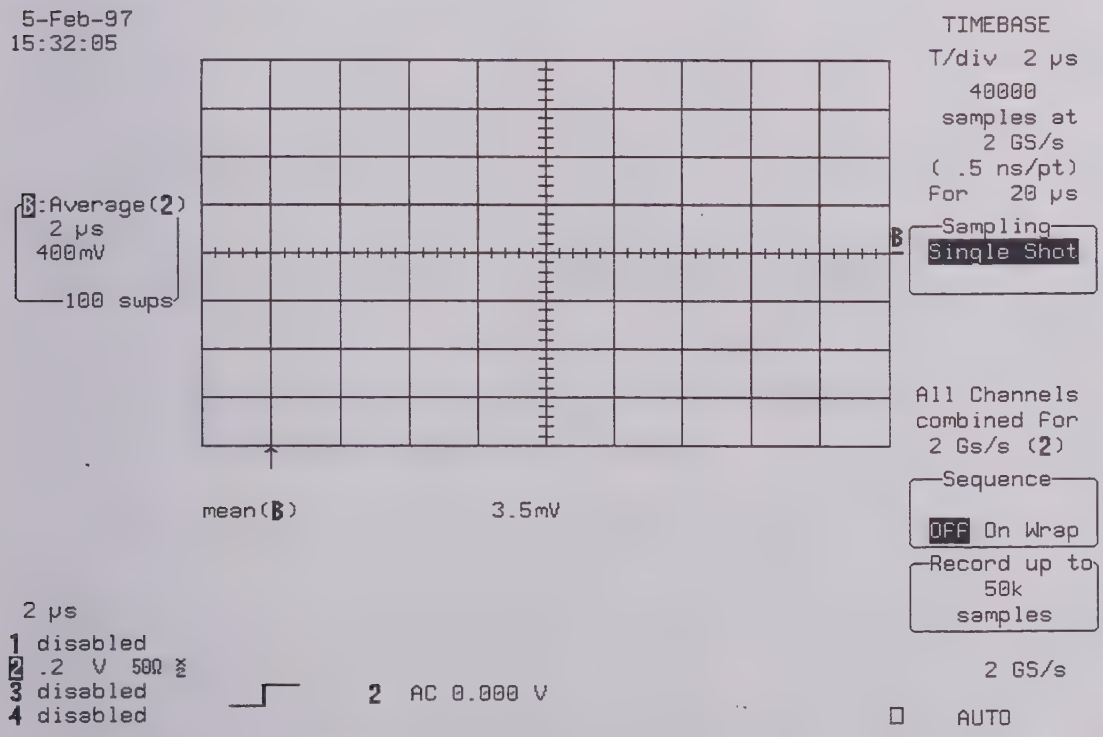
- Recall **534P029.PNL** or configure the DSO as shown in 4.6.3.a. and make the following changes :

Input Coupling	:	**DC 50Ω** on all 4 Channels
Input gain	:	**0.2 V/div.** on all 4 Channels
Timebase	:	**2 µsec/div.**
Change parameters		
On line 1	:	**Measure Mean of B**

- Connect a PP093 adapter to Channel 2 and Channel 3.
- Check :
- PP093 is identified on **Channel 2**
- Channel 1, Channel 3 and Channel 4 are **disabled**
- Sampling rate is **2 GS/s**

- Press **Clear Sweeps.**

- After **100 sweeps** record the **mean** value of **B** in Table 7, and compare the test result to the limits in the test record.



- Disconnect the **PP093** adapter.

4.7 DC Accuracy

Specification

≤ ±3 % of full scale at 5mV/div, with 0 mV offset.
≤ ±2 % of full scale at 10mV/div and above, with 0 mV offset.

Description

This test measures the DC Accuracy within the gain range specified.
It requires a DC source with a voltage range of 0 V to 20 V adjustable in steps of no more than 15 mV, and a calibrated DMM that can measure voltage to 0.1 %.
Measurements are made using voltage values applied by the external voltage reference source, measured by the DMM, and in the oscilloscope using the parameters Std voltage.
For each known input voltage, the deviation is checked against the tolerance.

4.7.1 Positive DC Accuracy

a. DC 50Ω

Procedure

- Recall **534P030.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 50Ω** on all 4 Channels
Input offset	:	**0.0 mV** on all 4 Channels
Input gain	:	from **5mV/div to 1 V/div.** (see Table 8) on all 4 Ch
Coupling 1	:	**DC**
Slope 1	:	**Pos.**
Mode	:	**Auto**
Holdoff	:	**Off**
Timebase	:	**2 msec/div**.
Channel use	:	**4**
Record up	:	**50 k**
Channels Trace OFF		**Channel 1, Channel 2, Channel 3 & Channel 4**
Zoom+Math Trace ON		**A, B, C & D**
Select Math Setup		
For Math	:	**Use at most 5000 points**
Redefine A, B, C, D		**Channel 1, Channel 2, Channel 3 & Channel 4**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg. Type	:	**Summed**
For	:	**100 sweeps**

Cursors/Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**off**

Change parameters

On line 1	:	**Measure mean of A**
On line 2	:	**Measure mean of B**
On line 3	:	**Measure mean of C**
On line 4	:	**Measure mean of D**

- For the low sensitivities : **5 mV, 10 mV and 20 mV/div**., connect the test equipment as shown in Figure 4-1.

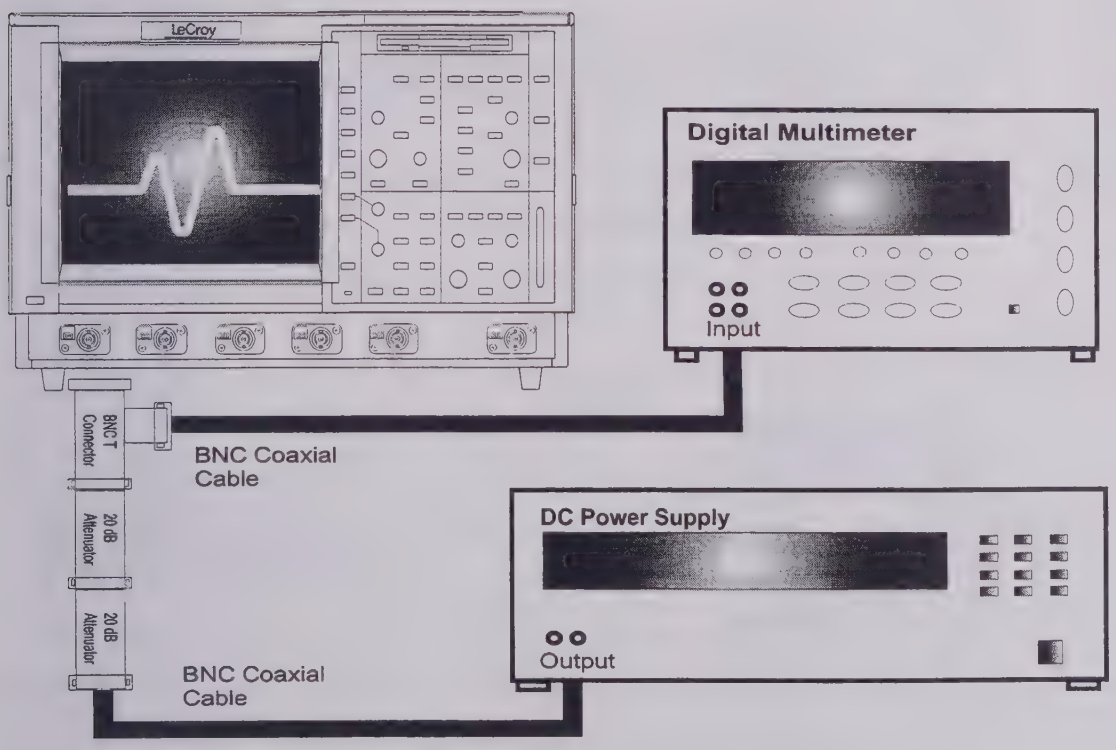


Figure 4-1 : DC 50Ω Accuracy Equipment Setup for 5, 10 and 20 mV/div

- For the sensitivities : 50 mV and 100 mV/div, connect the test equipment as shown in Figure 4-2.
- For the range 1 V/div no attenuator is required, connect the test equipment as shown in Figure 4-3.

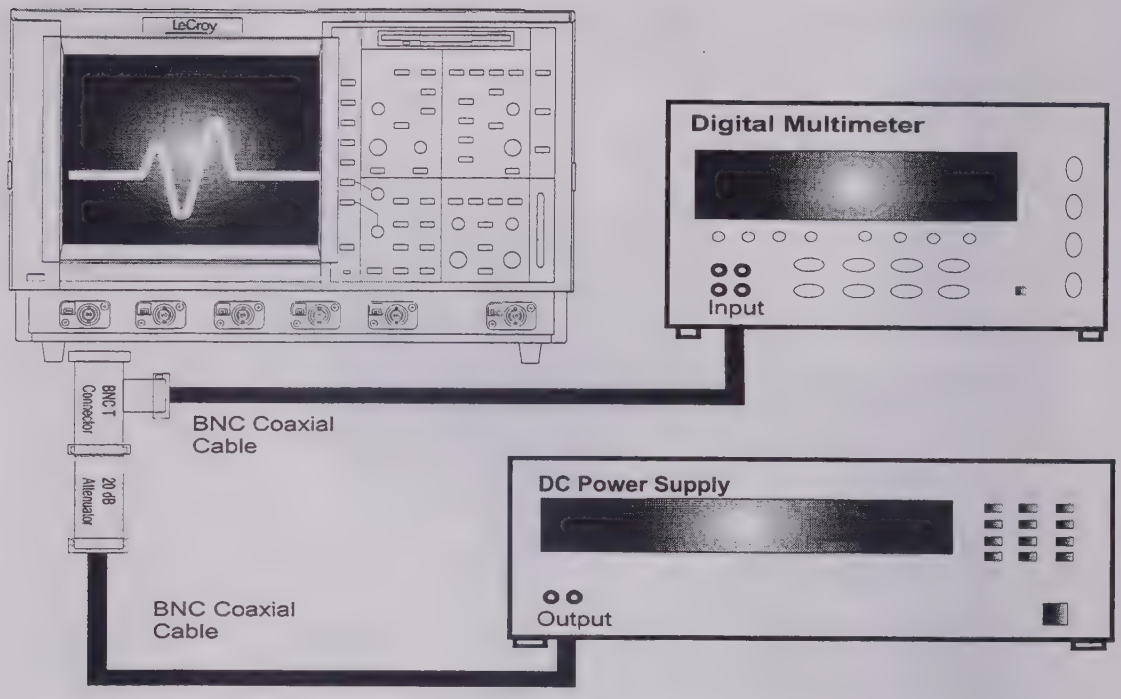


Figure 4-2 : DC 50Ω Accuracy Equipment Setup for 50 and 100 mV/div

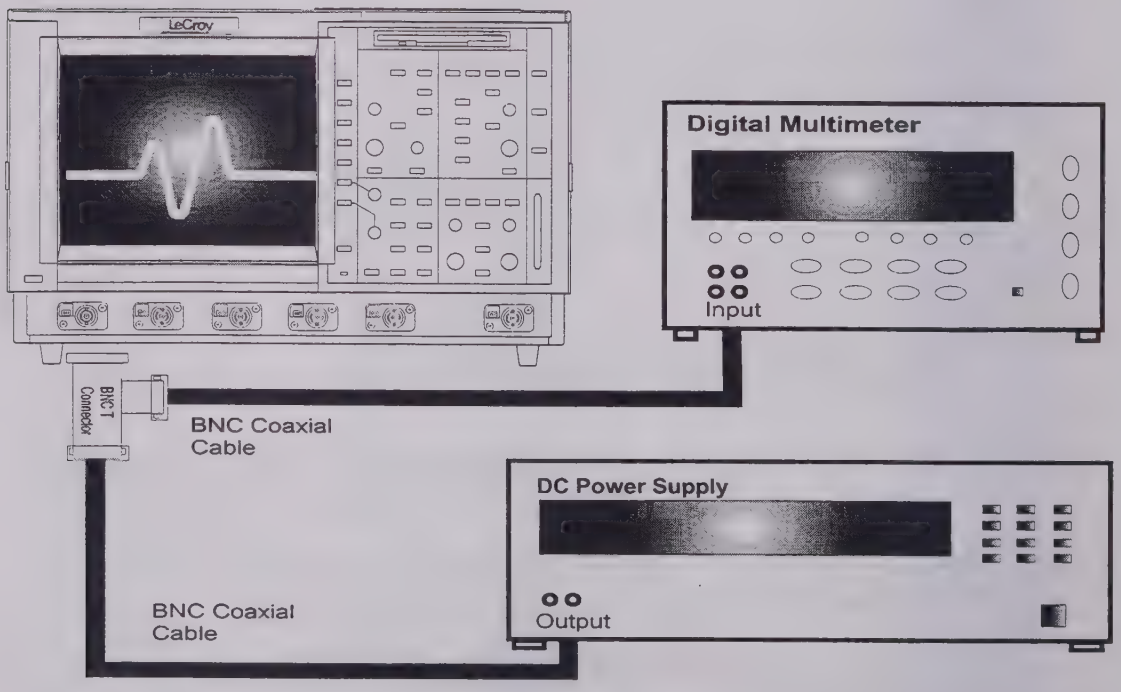


Figure 4-3 : DC 50Ω Accuracy Equipment Setup for 1 V/div.

- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 8, column PS output.

  1) Connect the DMM and record the **voltage reading** in Table 8, column **DMM.**

  2) Disconnect the DMM from the BNC T connector.

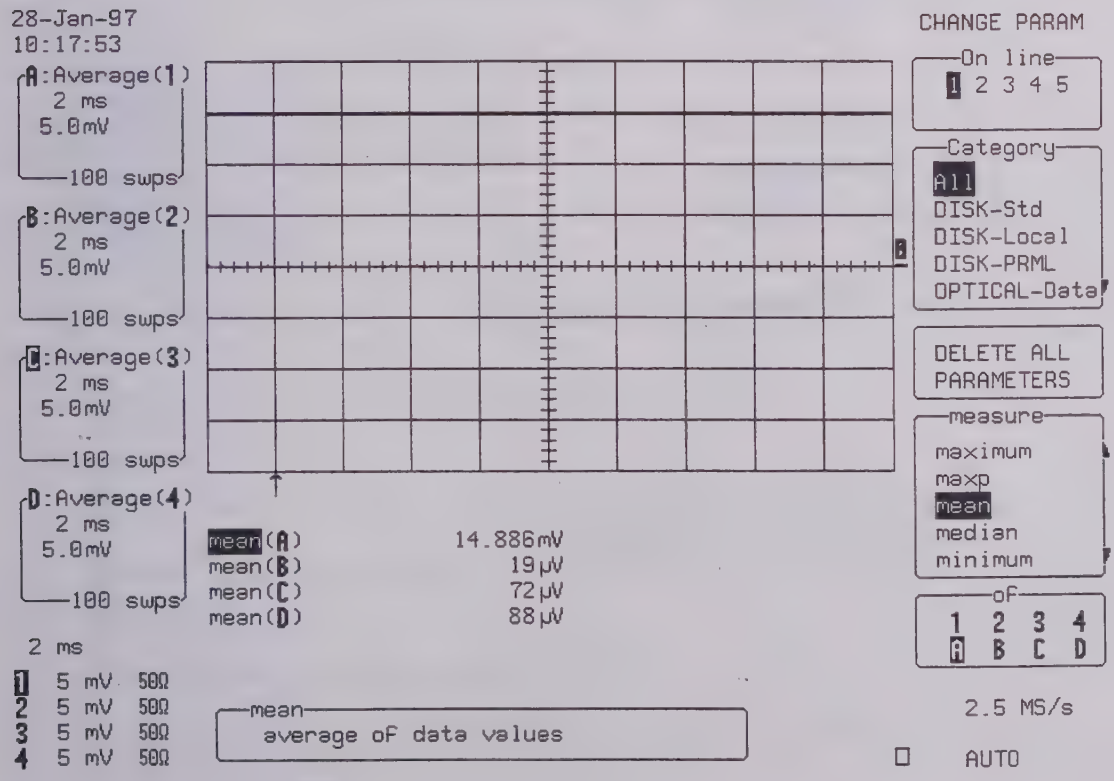
  3) Press **Clear Sweeps**

  4) After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 8, column **Mean**.

- For each DC voltage applied to the DSO input, repeat parts 1), 2), 3) and 4).

- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 8, and compare the **Difference (Δ)** to the corresponding limit in the test record.

- Repeat step 4.7.1.a. for the other channels, substituting channel controls and input connector.



b. DC 1MΩ

Procedure

- Recall **534P031.PNL** or configure the DSO as shown in 4.7.1.a. and make the following change :

  Input Coupling : **DC 1MΩ** on all 4 Channels

- For 5 mV/div., connect the test equipment as shown in Figure 4-4.

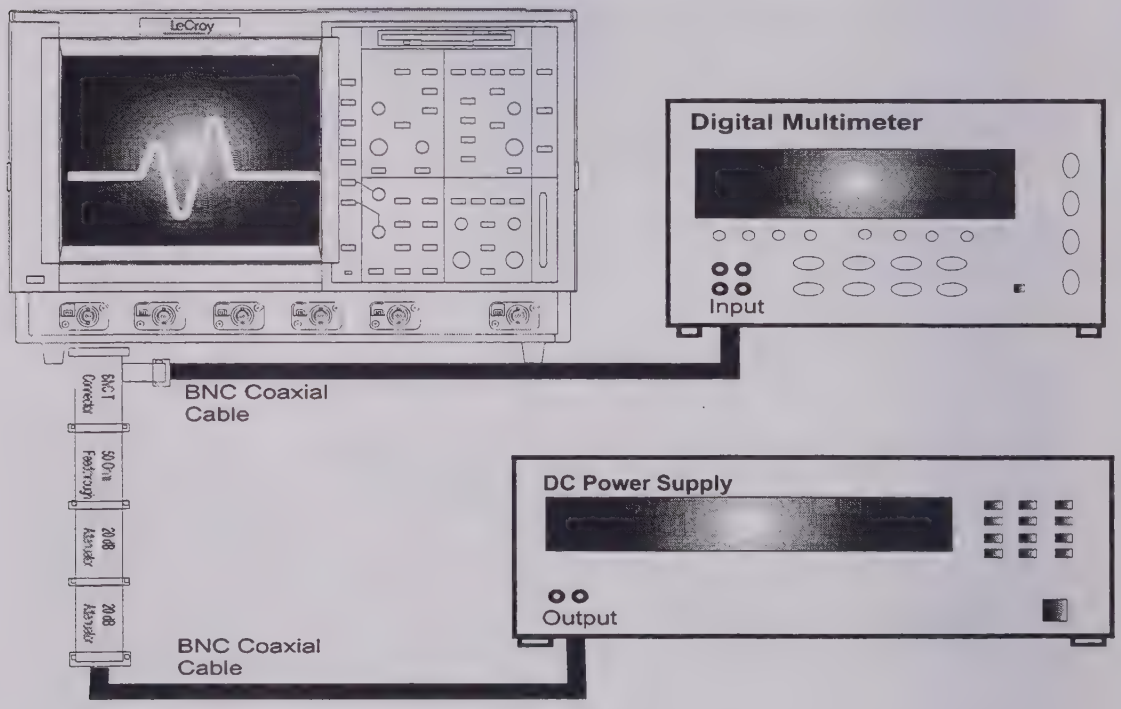


Figure 4-4: DC 1MΩ Accuracy Equipment Setup for 5 mV/div.

- For 100 mV/div, connect the test equipment as shown in Figure 4-5.
- For 5V/div no attenuator is required, connect the test equipment as shown in Figure 4-6.

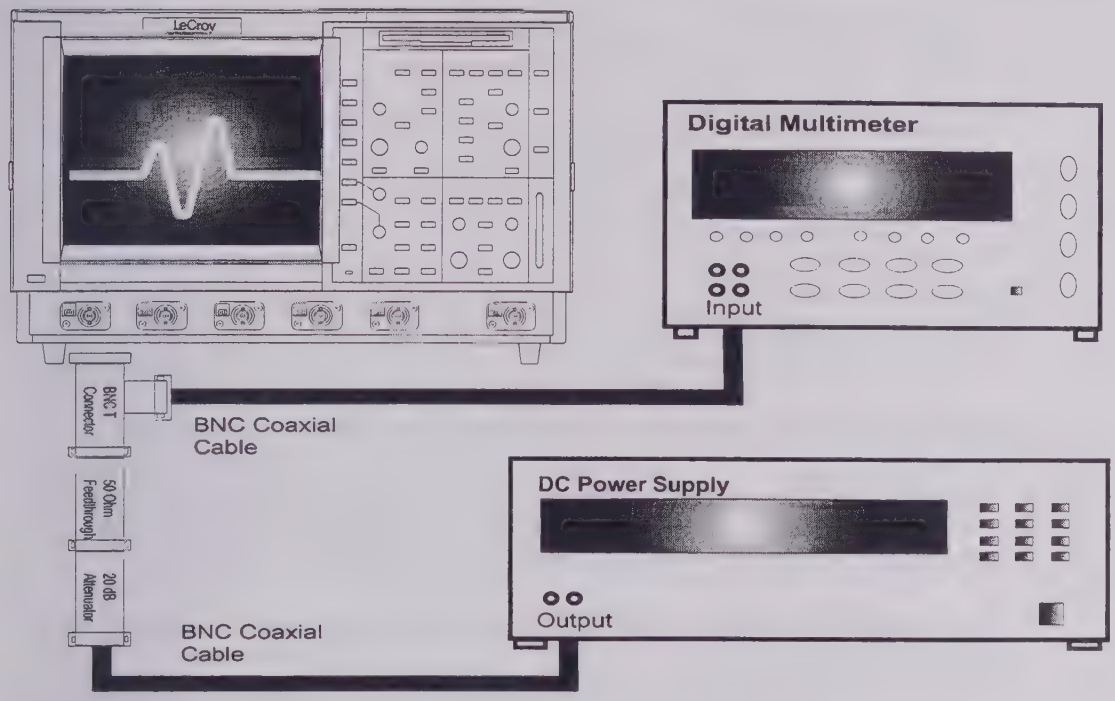


Figure 4-5 : DC 1MΩ Accuracy Equipment Setup for 100 mV/div

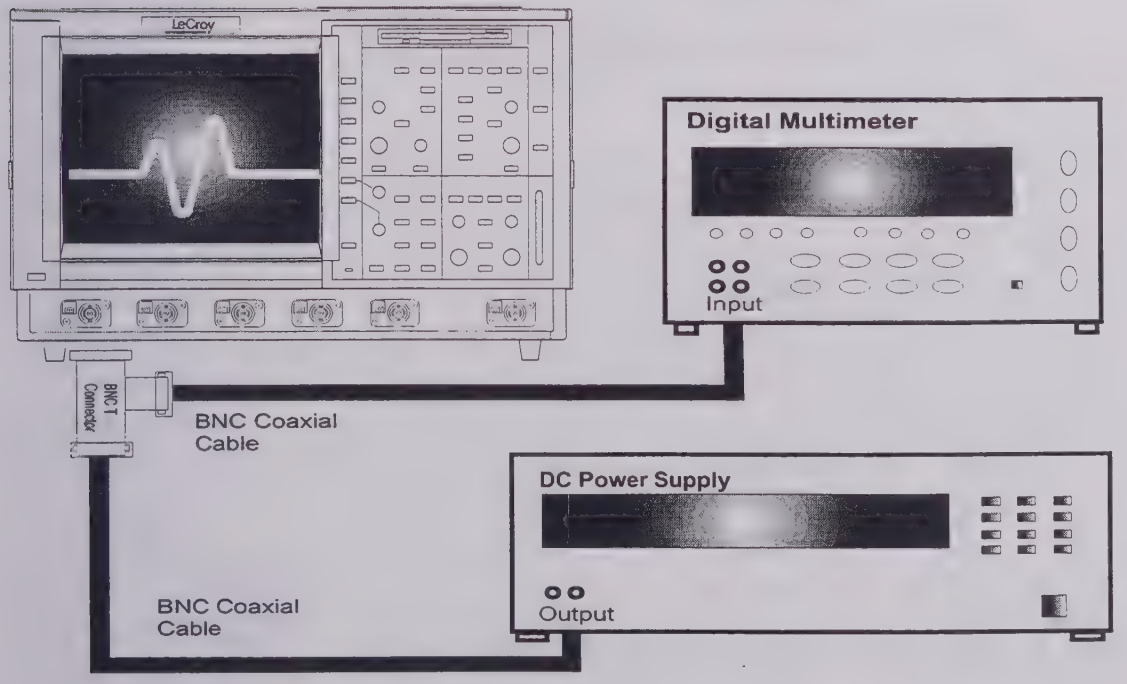


Figure 4-6 : DC 1MΩ Accuracy Equipment Setup for 5V/div.

- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 9, column PS output.

  1) Connect the DMM and record the **voltage reading** in Table 9, column **DMM.**

  2) Disconnect the DMM from the BNC T connector.

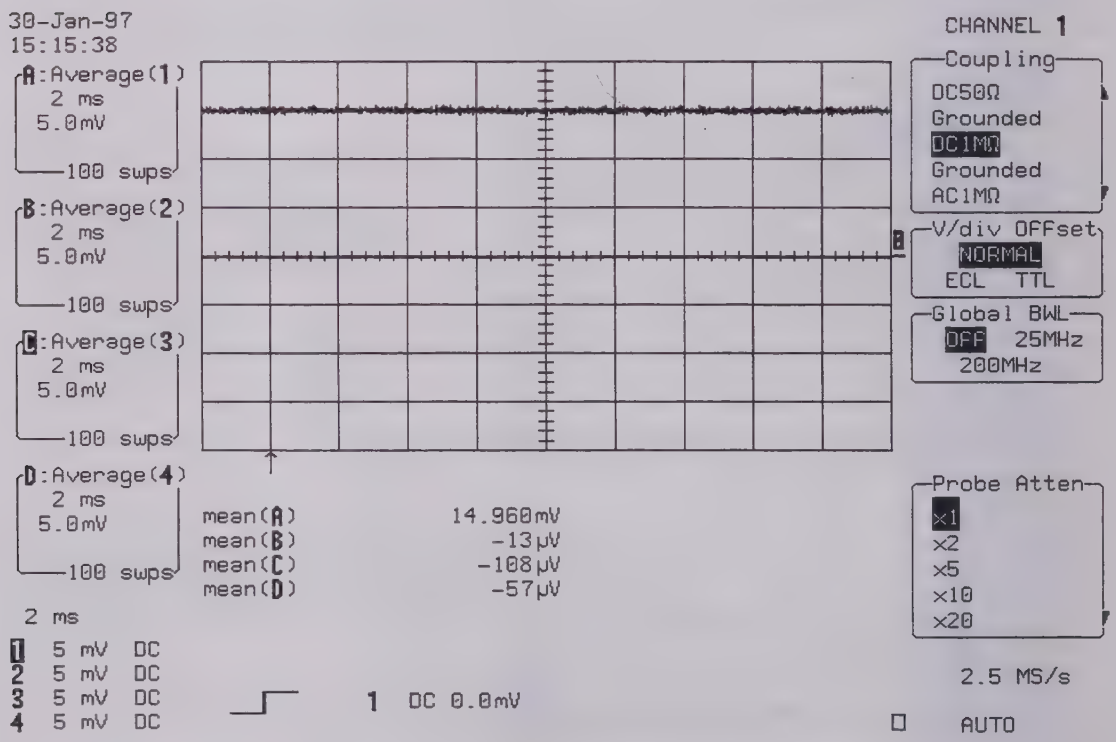
  3) Press **Clear Sweeps**

  4) After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 9, column **Mean**.

- For each DC voltage applied to the DSO input, repeat parts 1), 2), 3) and 4).

- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 9, and compare the **Difference (Δ)** to the corresponding limit in the test record.

- Repeat step 4.7.1.b. for the other channels, substituting channel controls and input connector.



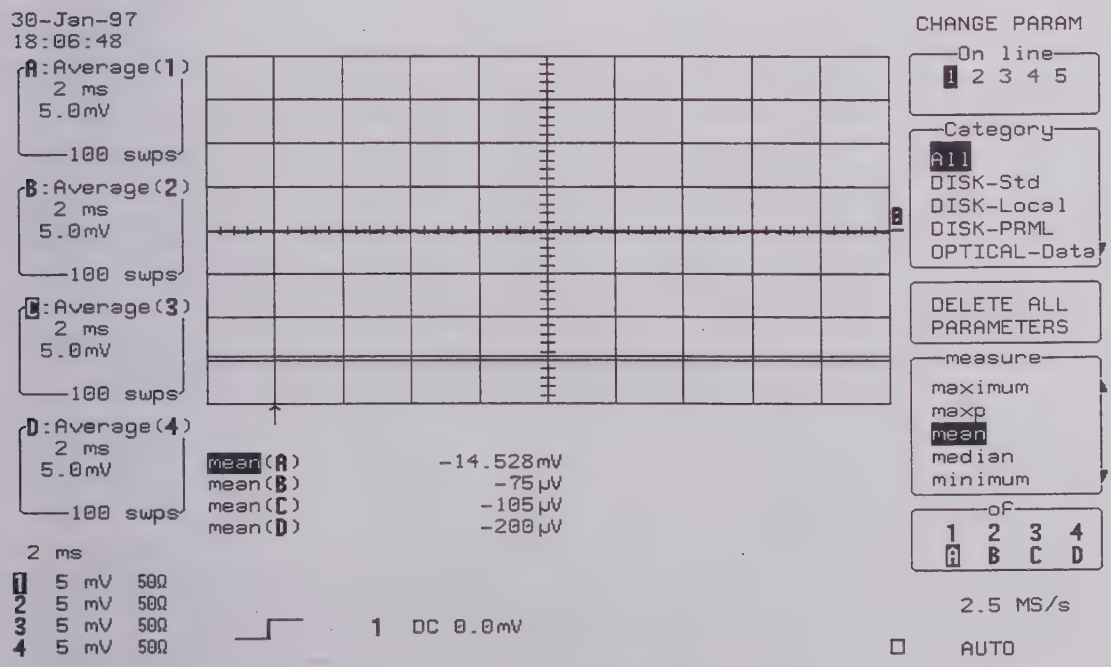
4.7.2 Negative DC Accuracy

a. DC 50Ω

- Recall **534P030.PNL** or configure the DSO as shown in 4.7.1.a.
- Connect the test equipment as shown in either Figure 4-1 or 4-2 or 4-3.
- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 10, column PS output. (if a banana-BNC adapter is being used it can simply be turned to get the opposite polarity)

  1) Connect the DMM and record the **voltage reading** in Table 10, column **DMM.**
  2) Disconnect the DMM from the BNC T connector.
  3) Press **Clear Sweeps**
  4) After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 10, column **Mean**.

- For each DC voltage applied to the DSO input, repeat parts 1), 2), 3) and 4).
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 10, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat step 4.7.2.a. for the other channels, substituting channel controls and input connector.



b. DC 1 MΩ

- Recall **534P031.PNL** or configure the DSO as shown in 4.7.1.a. and make the following change :

  Input Coupling : **DC 1 MΩ** on all 4 Channels

- Connect the test equipment as shown in either Figure 4-4 or 4-5 or 4-6.

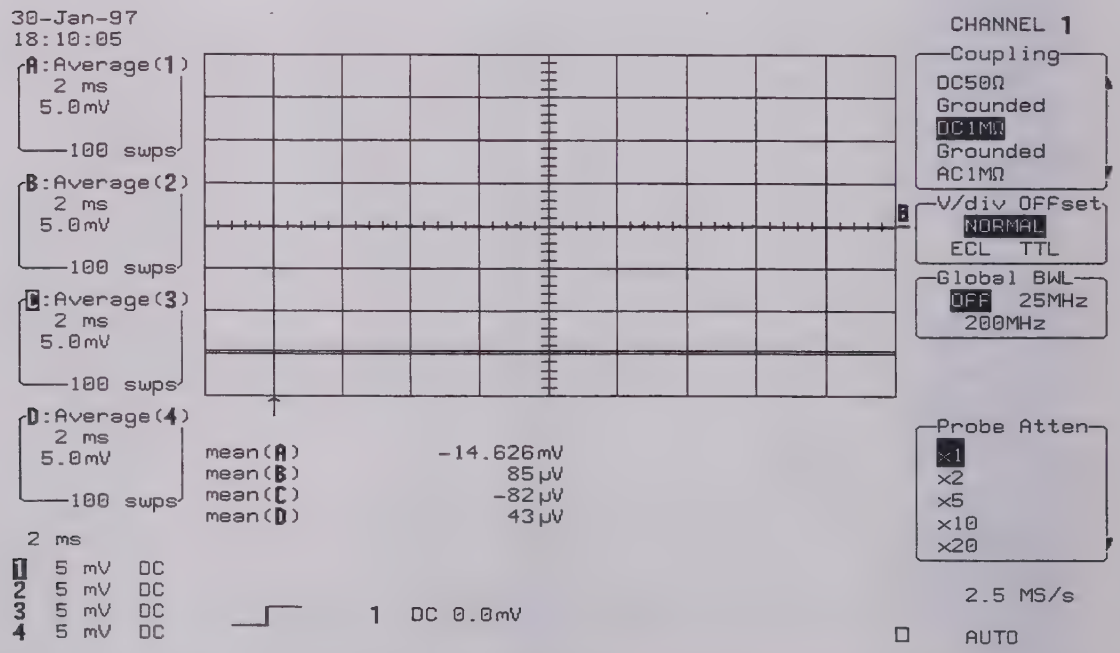
- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 11, column PS output.

  1) Connect the DMM and record the **voltage reading** in Table 11, column **DMM.**
  2) Disconnect the DMM from the BNC T connector.
  3) Press **Clear Sweeps**
  4) After 100 sweeps, read off the **DSO mean parameter**, and record the measurement in Table 11, column **Mean**.

- For each DC voltage applied to the DSO input, repeat parts 1), 2), 3) and 4).

- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 11, and compare the **Difference (Δ)** to the corresponding limit in the test record.

- Repeat step 4.7.2.b. for the other channels, substituting channel controls and input connector.



4.8 Offset Accuracy

Specifications

Offset range ±1 Volt at 5 mV/div
Accuracy ≤ ±11.2 mV (3 % of full scale +1 % of offset).

Description

The offset test is done at 5 mV/div, for 50Ω and 1MΩ couplings, with a signal of ±1 Volt cancelled by an offset of the other polarity.

4.8.1 Positive Offset Accuracy

a. DC 50Ω

Procedure

- Recall **534P032.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 50Ω** on all 4 Channels
Input gain	:	**5mV/div** on all 4 Channels
Input offset	:	**+1 Volt** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**1**
Coupling 1	:	**DC**
Slope 1	:	**Pos.**
Mode	:	**Auto**
Timebase	:	**2 msec/div**.
Channel use	:	**4**
Record up	:	**50 k**
Channels Trace OFF		**Channel 1, Channel 2, Channel 3 & Channel 4**
Zoom+Math Trace ON		**A, B, C & D**
Select Math Setup		
For Math	:	**Use at most 5000 points**
Redefine A, B, C, D		**Channel 1, Channel 2, Channel 3 & Channel 4**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg. Type	:	**Summed**
For	:	**100 sweeps**
Cursors/Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**off**

Change parameters

On line 1	:	**Measure mean of A**
On line 2	:	**Measure mean of B**
On line 3	:	**Measure mean of C**
On line 4	:	**Measure mean of D**

- Connect the test equipment as shown in Figure 4-7.

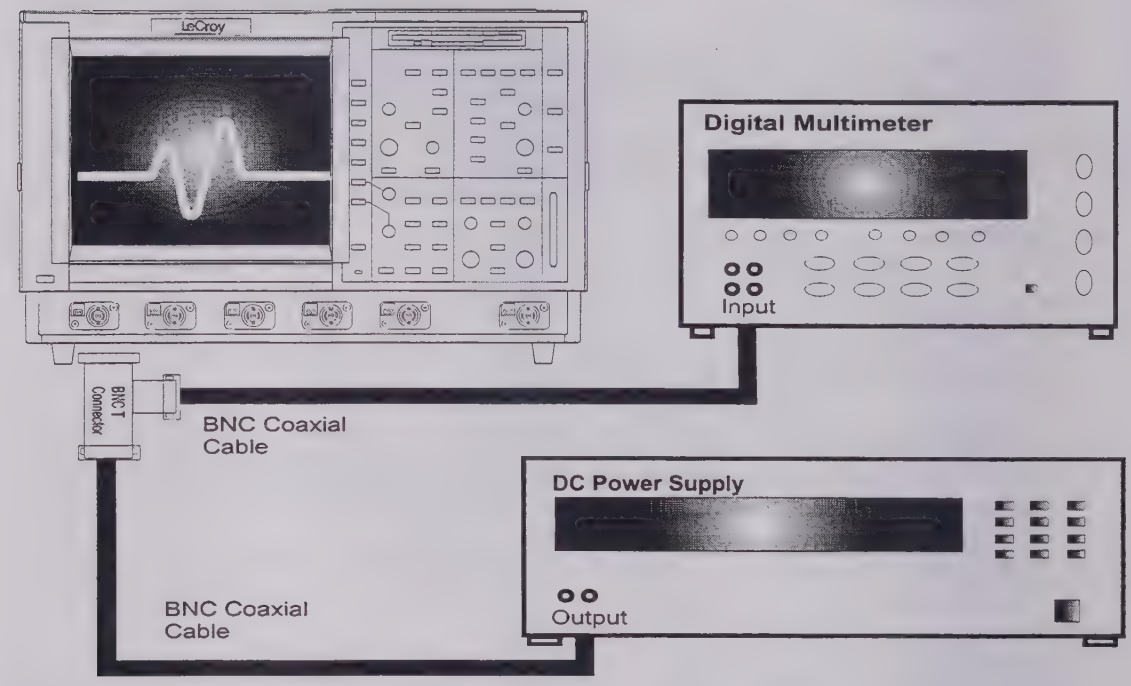
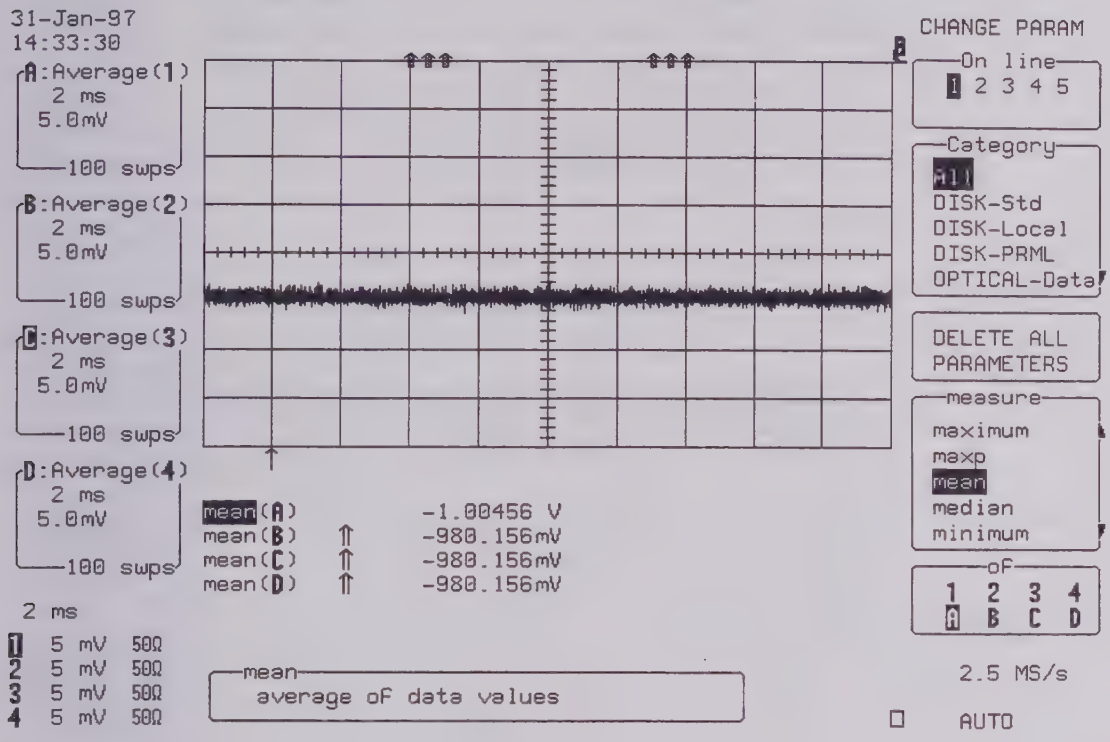


Figure 4-7 : Offset Accuracy Equipment Setup

- Set the output of the external **DC voltage reference source** to **–1 Volt**.
- Verify that the displayed trace A : Average (1) is in the screen, near to the center horizontal graticule line.
- Connect the DMM and record the **voltage reading** in Table 12, column **DMM**.
- Disconnect the DMM from the BNC T connector.
- Press **Clear Sweeps**
- After 100 sweeps, Read off the **DSO Mean parameter** voltage, and record the measurement in Table 12, column **Mean**.



- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 12, and compare the **Difference (Δ)** to the corresponding limit in the test record.

- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 12.

b. DC 1MΩ

Procedure

- Recall **534P033.PNL** or configure the DSO as shown in 4.8.1.a. and for each Channel make the following change :

  Input Coupling : **DC 1MΩ**

- Connect the test equipment as shown in Figure 4-7.

- Set the output of the external **DC voltage reference source** to **–1 Volt**.

- Verify that the displayed trace A : Average (1) is in the screen, near to the center horizontal graticule line.
- Connect the DMM and record the **voltage reading** in Table 12, column **DMM**.
- Disconnect the DMM from the BNC T connector.
- Press **Clear Sweeps**
- After 100 sweeps, Read off the **DSO Mean parameter** voltage, and record the measurement in Table 12, column **Mean**.
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 12, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 12.

4.8.2 Negative Offset Accuracy

a. DC 50Ω

Procedure

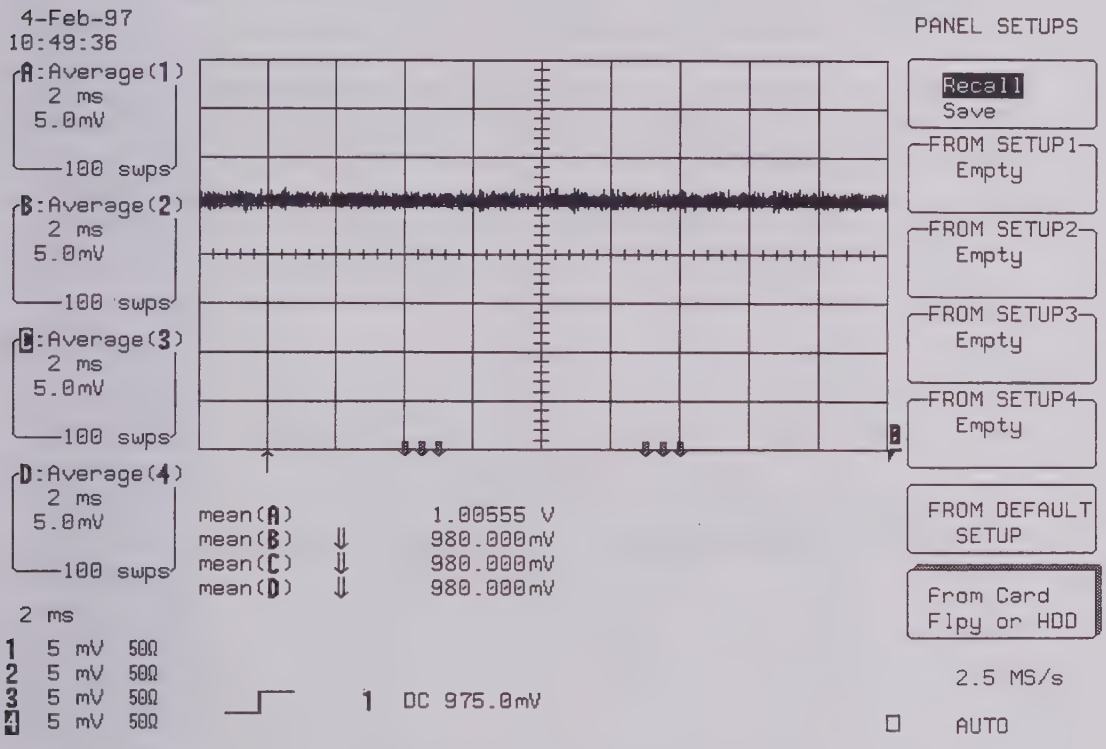
- Recall **534P034.PNL** or configure the DSO as shown in 4.8.1.a. and for each Channel make the following change :

  Input offset : **–1 Volt**

- Connect the test equipment as shown in Figure 4-7.
- Set the output of the external **DC voltage reference source** to **+1 Volt**.
- Verify that the displayed trace A : Average (1) is in the screen, near to the center horizontal graticule line.
- Connect the DMM and record the **voltage reading** in Table 13, column **DMM**.
- Disconnect the DMM from the BNC T connector.
- Press **Clear Sweeps**
- After 100 sweeps, Read off the **DSO Mean parameter** voltage, and record the measurement in Table 13, column **Mean**.

- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 13, and compare the **Difference (Δ)** to the corresponding limit in the test record.

- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 13.



b. DC 1MΩ

- Recall **534P035.PNL** or configure the DSO as shown in 4.8.1.a. and for each Channel make the following changes :

  Input Coupling : **DC 1MΩ**

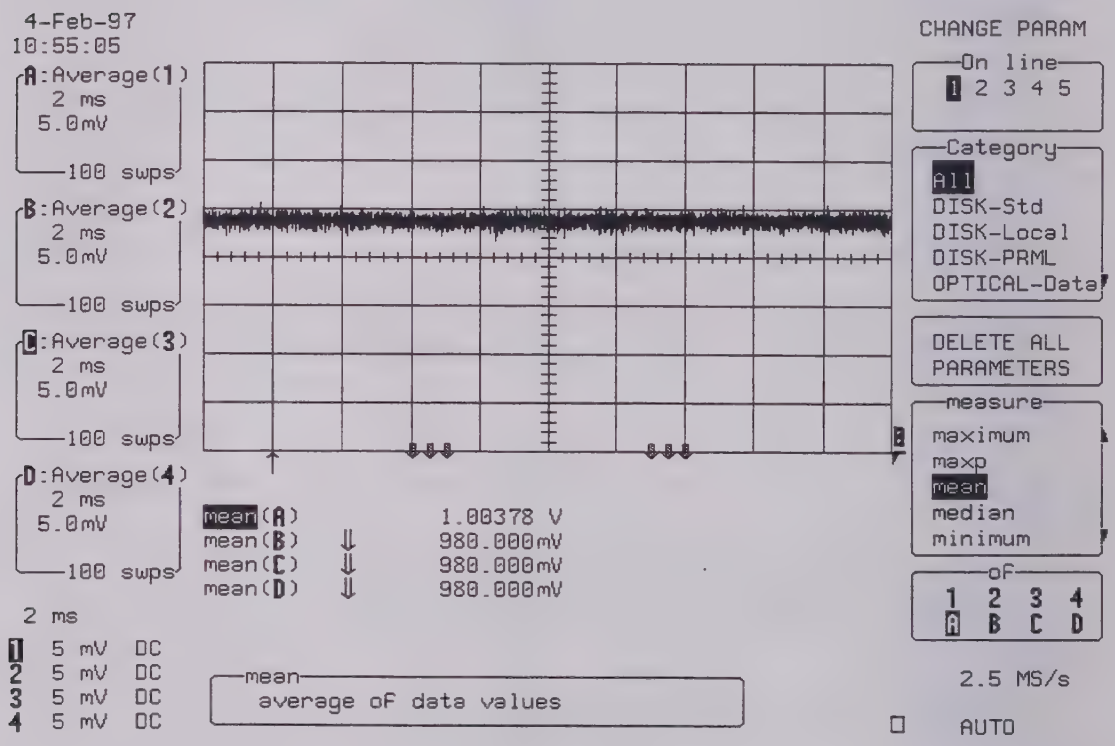
  Input offset : **–1 Volt**

- Connect the test equipment as shown in Figure 4-7.

- Set the output of the external **DC voltage reference source** to **+1 Volt**.

- Verify that the displayed trace A : Average (1) is in the screen, near to the center horizontal graticule line.

- Connect the DMM and record the **voltage reading** in Table 13, column **DMM**.
- Disconnect the DMM from the BNC T connector.
- Press **Clear Sweeps**
- After 100 sweeps, Read off the **DSO Mean parameter** voltage, and record the measurement in Table 13, column **Mean**.
- Calculate the **Difference (Δ)** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 13, and compare the **Difference (Δ)** to the corresponding limit in the test record.
- Repeat the test for the other channels, substituting channel controls and input connector. Record the measurements in Table 13.



4.9 Bandwidth

4.9.1 Description

The purpose of this test is to ensure that the entire system has a bandwidth of at least 1 GHz. An external source is used as the reference to provide a signal where amplitude and frequency are well controlled.
The amplitude of the generator as a function of frequency and power is calibrated using an HP8482A sensor on an HP436A power meter or equivalent.

Specifications

50Ω : DC to at least 1 GHz (–3 dB) at 10 mV/div. and above.

1MΩ : DC to 400 MHz typical at 100 mV/div

a. DC 50Ω

- Recall **534P036.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 50Ω** on all 4 Channels
Input gain	:	**50mV/div** on all 4 Channels
Input offset	:	**0 mV** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**Line**
Slope line	:	**Pos**
Mode	:	**Auto**
Timebase	:	**10 µsec/div.**
Channel use	:	**4**
Record up	:	**50 k**
Cursors/Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**On**
Change parameters		
On line 1	:	**Sdev of 1**
On line 2	:	**Sdev of 2**
On line 3	:	**Sdev of 3**
On line 4	:	**Sdev of 4**

- Connect the HP8482A power sensor to the power meter.
- Zero and **calibrate** the HP8482A power sensor using the power meter **Power Ref output**.

- Connect a **BNC adapter** to the HP8482A power sensor.
- Connect a 5ns 50 BNC cable to the **RF output** of the HP8648B generator and then through the necessary adapters to the power sensor.

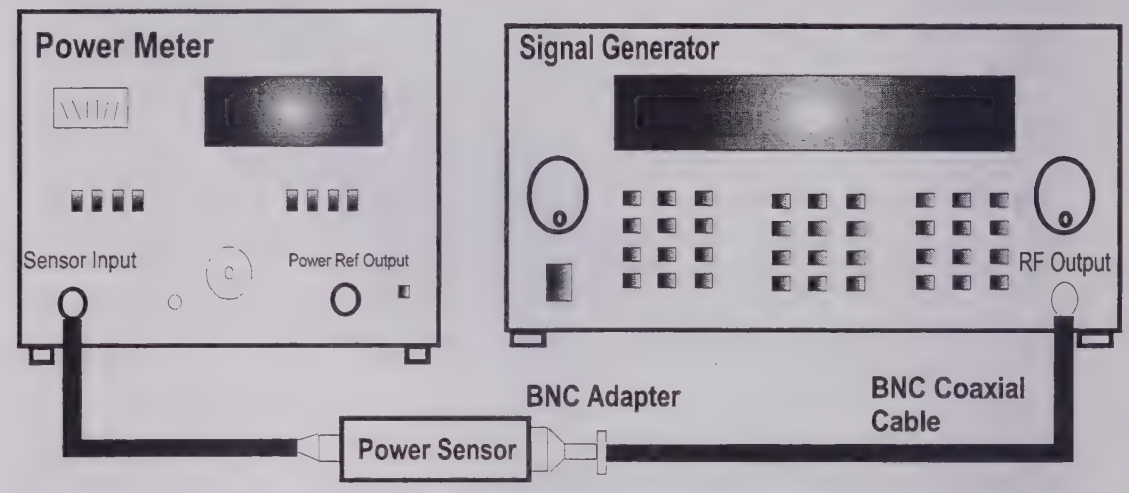


Figure 4-8 : Power Meter Equipment Setup

- Set the generator frequency to **300 KHz**
- Set the generator amplitude to measure **0.200 mW** on the power meter.
- Read the displayed **generator output amplitude,** and record it in the third column of Table 14.
- Repeat the above measurement for **1.1 MHz**, **30.1 MHz**, **250.1 MHz**, **750.1 MHz** & **1000.1 MHz**. Record the generator output amplitude readout in the third column of Table 14.
- Disconnect the **RF output** of the HP8648B generator from the HP8482A power sensor.
- Connect the **RF output** of the HP8648B generator through the 5ns 50 Ohm BNC cable into Channel 1.
- Set the generator frequency to **300 KHz**.
- From the generator, apply the **recorded generator signal amplitude** to Channel 1.
- Press **Clear Sweeps**.

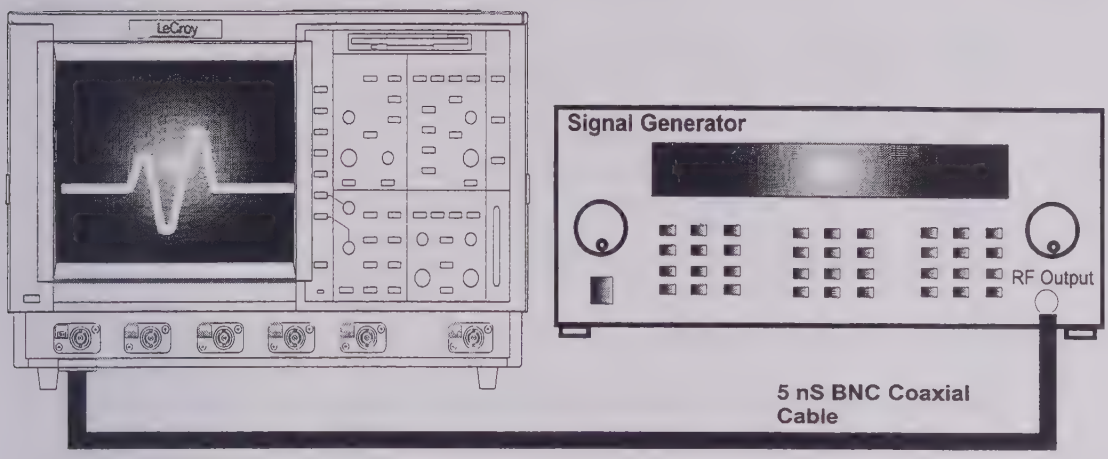
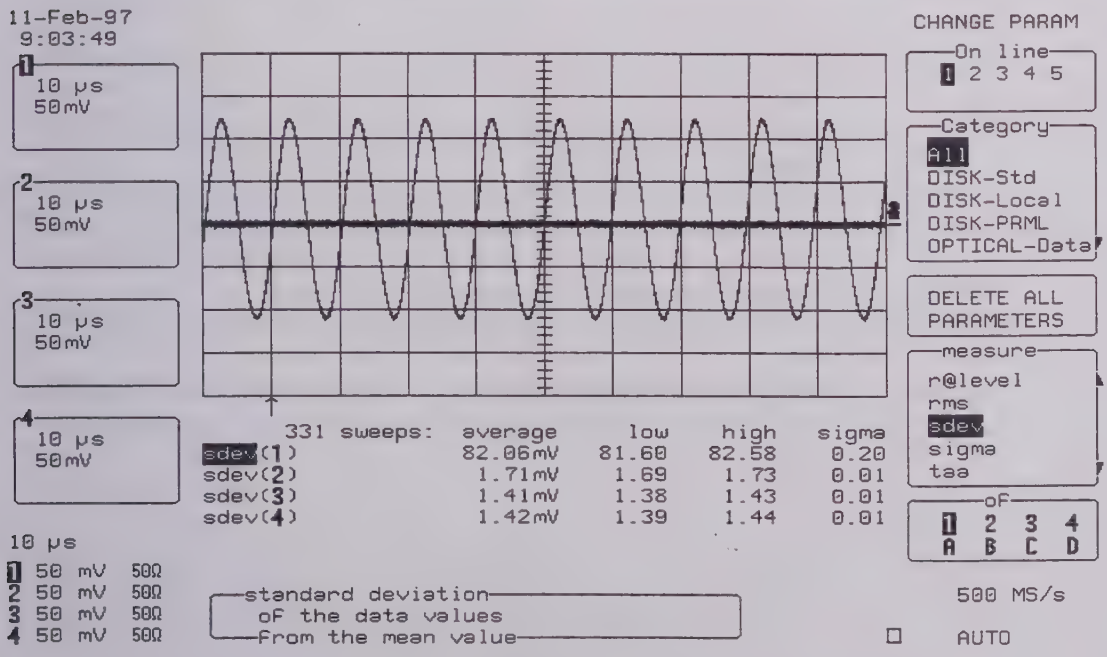


Figure 4-9 : 50Ω Bandwidth Equipment Setup

- Measure for at least 100 sweeps, record the average value of **sdev(1)** inTable14
- Repeat the above 3 steps for Channel 2, Channel 3 & Channel 4 substituting channel controls and input connector. Record the measurements in Table 14.
- Repeat the above measurement for all channels for 1.1 MHz, 30.1 MHz, 250.1 MHz, 750.1 MHz and 1000.1 MHz and record the values in Table 14.
- Calculate the ratio to .3 MHz for each frequency, $sdev_{1.1}/sdev_{0.3}$, $sdev_{30.1}/sdev_{0.3}$ ...$sdev_{1000.1}/sdev_{0.3}$, and compare the results to the limits in the test record.



- Recall **534P037.PNL** or configure the DSO as shown in 4.9.1.a. and for each Channel make the following change :

  Input gain : **100mV/div**

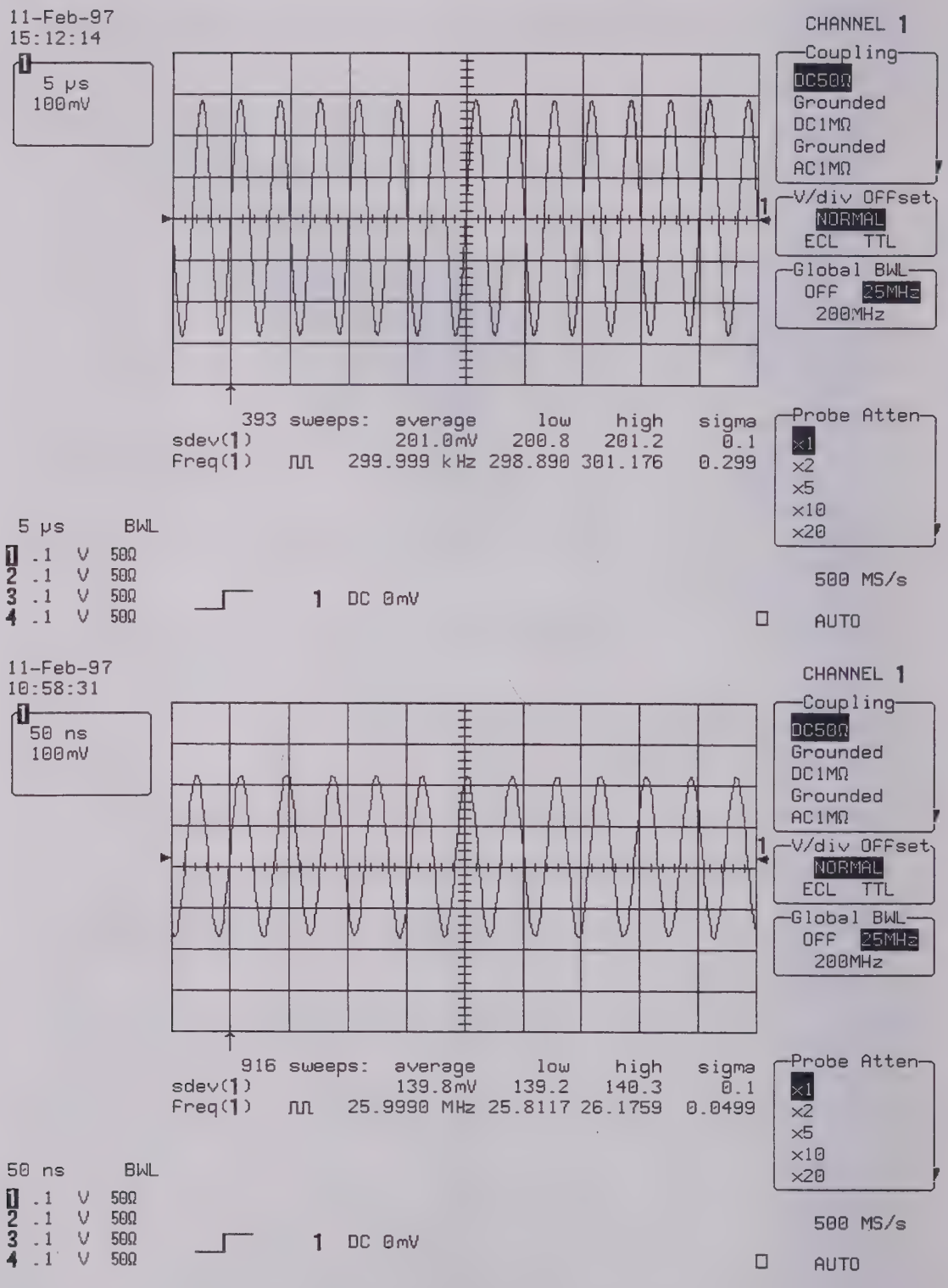
- Connect the test equipment as shown in Figure 4-8.
- Set the generator frequency to **300 kHz**
- Set the generator amplitude to measure **0.800 mW** on the power meter.
- Read the displayed **generator output amplitude,** and record it in the third column of Table 15.
- Repeat the above measurement for **1.1 MHz**, **30.1 MHz**, **250.1 MHz**, **750.1 MHz** & **1000.1 MHz**. Record the generator output amplitude readout in the third column of Table 15.
- Disconnect the **RF output** of the HP8648B generator from the HP8482A power sensor.
- Connect the test equipment as shown in Figure 4-9.
- Set the generator frequency to **300 kHz**.
- From the generator, apply the **recorded generator signal amplitude** to Channel 1.
- Press **Clear Sweeps**.
- Measure for at least 100 sweeps, record the average value of **sdev(1)** inTable15
- Repeat the above 3 steps for Channel 2, Channel 3 & Channel 4 substituting channel controls and input connector. Record the measurements in Table 15.
- Repeat the above measurement for all channels for 1.1 MHz, 30.1 MHz, 250.1 MHz, 750.1 MHz and 1000.1 MHz and record the values in Table 15.
- Calculate the ratio to .3 MHz for each frequency, $sdev_{1.1}/sdev_{0.3}$, $sdev_{30.1}/sdev_{0.3}$ ...$sdev_{1000.1}/sdev_{0.3}$, and compare the results to the limits in the test record.

b. DC 50Ω with Bandwidth Limiter On

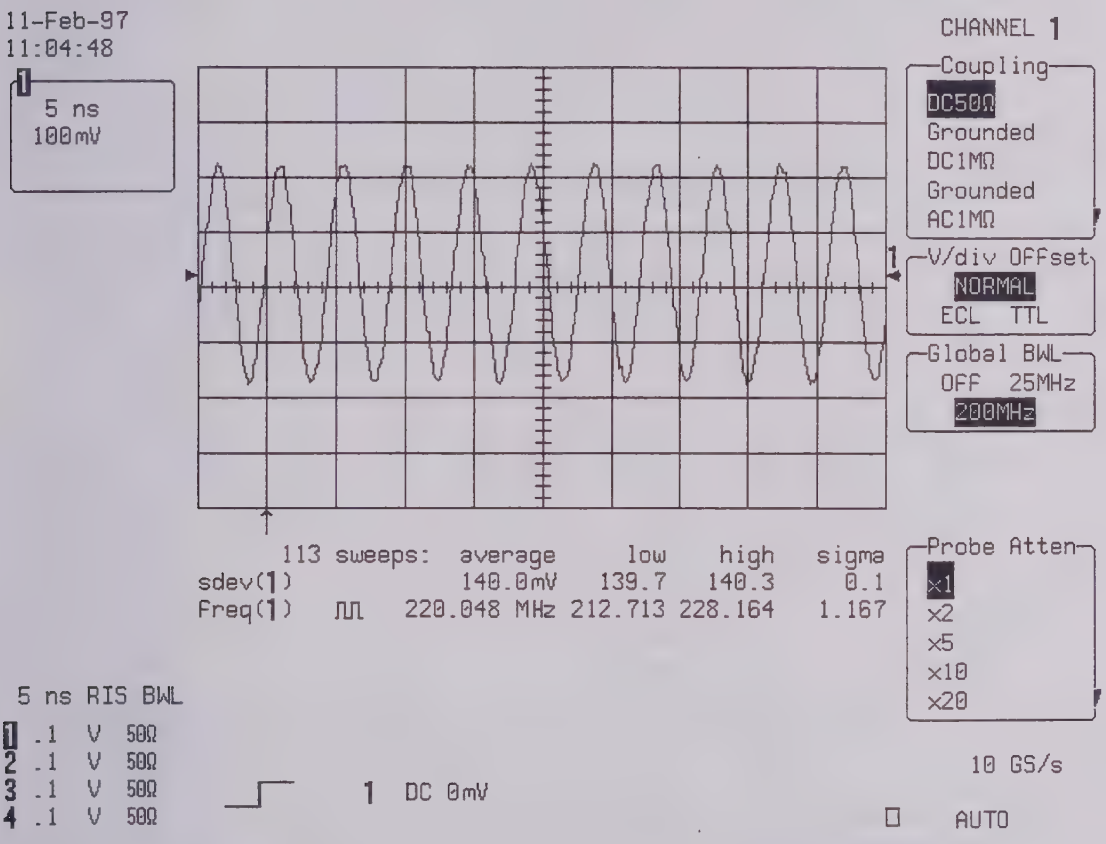
- Recall **534P038.PNL** or configure the DSO

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1**
Input Coupling	:	**DC 50Ω**
Global BWL	:	**25 MHz**
Input gain	:	**100 mV/div.**
Input offset	:	**0 mV**
Trigger setup	:	**Edge**
Trigger on	:	**1**
Slope line	:	**Pos**
Mode	:	**Auto**
Timebase	:	**5 µsec/div.**
Channel use	:	**4**
Record up	:	**50 k**
Cursors/Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**On**
Change parameters		
On line 1	:	**Sdev of 1**
On line 2	:	**Freq of 1**

- Connect the test equipment as shown in Figure 4-9.
- Set the generator frequency to **300 kHz**.
- Adjust the generator signal amplitude to measure **sdev(1) = 200 mV.**
- Set Timebase : **50 nsec/div**.
- Increase the generator frequency until **sdev(1) = 140 mV.** (typically 25 MHz)
- Press **Clear Sweeps**
- When **sdev(1) = 140 mV,** record Freq(1) in Table 16.
- Check that the frequency is within the limits specified in Table 16.


11-Feb-97
15:12:14
1
5 µs
100mV
CHANNEL 1
Coupling
DC50Ω
Grounded
DC1MΩ
Grounded
AC1MΩ
V/div OFFset
NORMAL
ECL TTL
Global BWL
OFF 25MHz
200MHz
393 sweeps: average low high sigma
sdev(1) 201.0mV 200.8 201.2 0.1
Freq(1) 299.999 kHz 298.890 301.176 0.299
Probe Atten
x1
x2
x5
x10
x20
5 µs BWL
1 .1 V 50Ω
2 .1 V 50Ω
3 .1 V 50Ω
4 .1 V 50Ω
1 DC 0mV
500 MS/s
AUTO
11-Feb-97
10:58:31
1
50 ns
100mV
CHANNEL 1
Coupling
DC50Ω
Grounded
DC1MΩ
Grounded
AC1MΩ
V/div OFFset
NORMAL
ECL TTL
Global BWL
OFF 25MHz
200MHz
916 sweeps: average low high sigma
sdev(1) 139.8mV 139.2 140.3 0.1
Freq(1) 25.9990 MHz 25.8117 26.1759 0.0499
Probe Atten
x1
x2
x5
x10
x20
50 ns BWL
1 .1 V 50Ω
2 .1 V 50Ω
3 .1 V 50Ω
4 .1 V 50Ω
1 DC 0mV
500 MS/s
AUTO

- Set Global BWL : **200 MHz**
- Set Timebase : **5 nsec/div**.
- Increase the generator frequency until **sdev(1) = 140 mV.** (typically 200 MHz)



- Press **Clear Sweeps**
- When **sdev(1) = 140 mV,** record Freq(1) in Table 16.
- Repeat the 25 MHz and 200 MHz Bandwidth limiter tests for the other channels, substituting channel controls and input connector.
- Recall **534P039.PNL** for Channel 2, **534P040.PNL** for Channel3 **534P041.PNL** for Channel 4, or configure the DSO as shown in 4.9.1.b. and make the necessary changes.
- Record the test results in Table 16, and compare the results to the limits.

4.9.2 DC 1MΩ

- Recall **534P042.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 1MΩ** on all 4 Channels
Input gain	:	**100 mV/div.** on all 4 Channels
Input offset	:	**0 mV** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**Line**
Slope line	:	**Pos**
Mode	:	**Auto**
Timebase	:	**10 μsec/div.**
Channel use	:	**4**
Record up	:	**50 k**
Cursors/Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**On**
Change parameters		
On line 1	:	**Sdev of 1**
On line 2	:	**Sdev of 2**
On line 3	:	**Sdev of 3**
On line 4	:	**Sdev of 4**

- Connect the test equipment as shown in Figure 4-10.

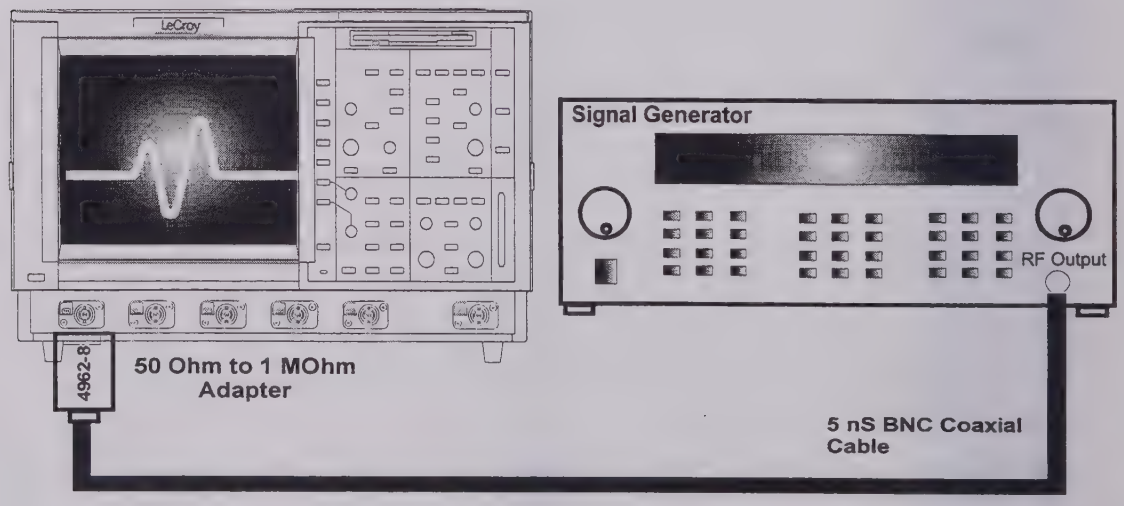
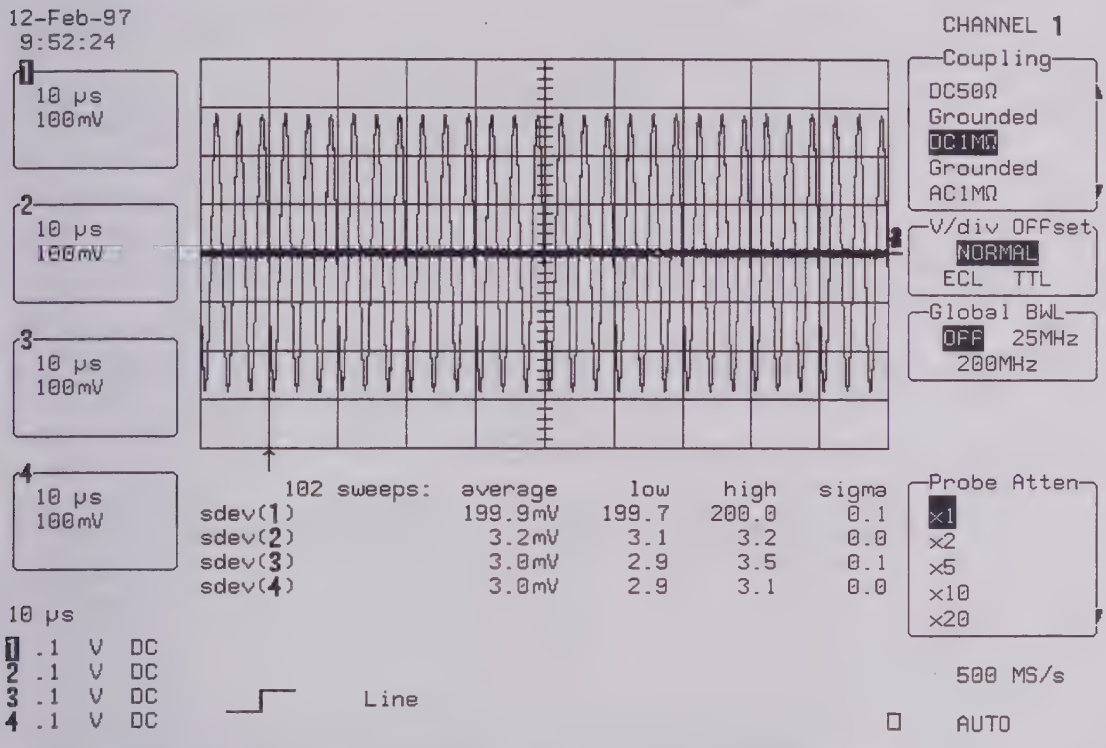


Figure 4-10 : 1MΩ Bandwidth Equipment Setup

- Set the generator frequency to **300 kHz**.
- Adjust the generator signal amplitude to measure **sdev(1) = 200 mV.**



- Disconnect the coaxial cable from the 4962-8 adapter. Connect the test equipment as shown in Figure 4-11.

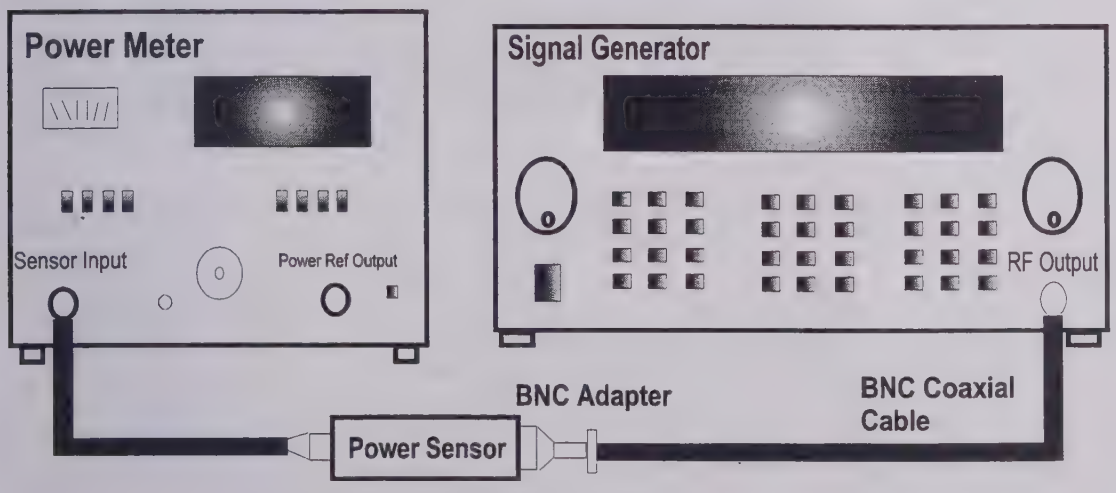
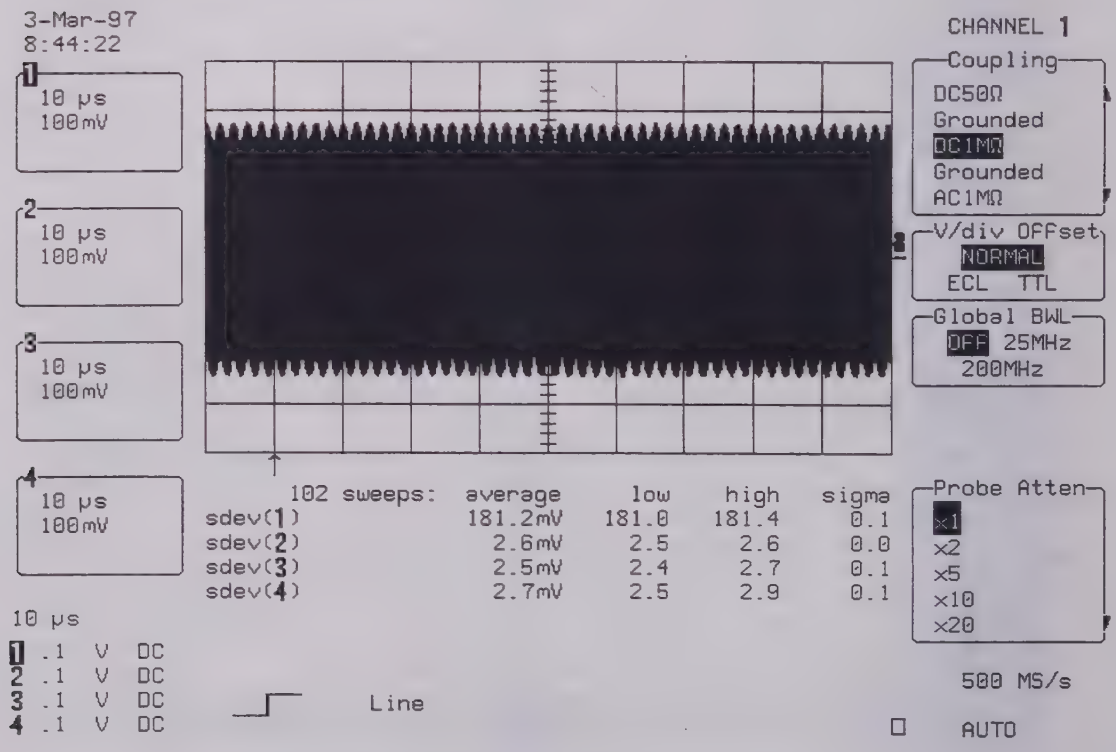


Figure 4-11 : Power Meter Equipment Setup

- Record the displayed power meter value in mW.
- Set the generator frequency to **400.1 MHz**.
- Now fine adjust the generator amplitude output until the power meter readout indicates the value measured just above at 300 kHz.
- Reconnect the signal generator to DSO Channel 1, as shown in Figure 4-10.
- Press **Clear Sweeps**.
- Measure for at least **100 sweeps**, record the average value of **sdev(1)** in Table17.
- Repeat the above steps for Channel 2, Channel 3 & Channel 4, substituting channel controls and input connector.
- Record the sdev measurements in Table17.
- Calculate the ratio **sdev**$_{400.1}$**/sdev**$_{0.3}$ for each Channel, and test each value against the limits shown in the test record.



4.10 Trigger Level

4.10.1 Description

The trigger capabilities are tested for several cases of the standard edge trigger :

- Channel (internal), and External Trigger sources
- Three DC levels : –3, 0, +3 major screen divisions
- DC, HFREJ coupling
- Positive and negative slopes

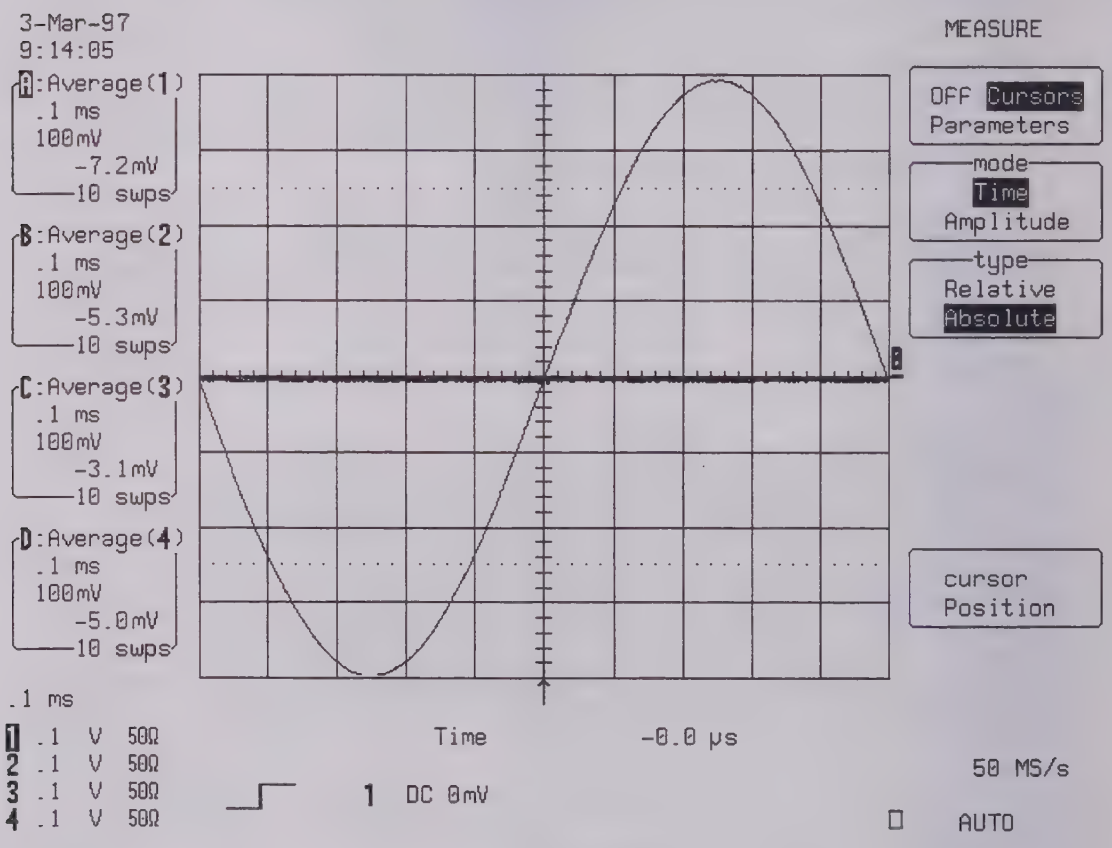
4.10.2 Channel Trigger at 0 Division Threshold

a. DC Coupling

Recall **534P043.PNL** or configure the DSO :

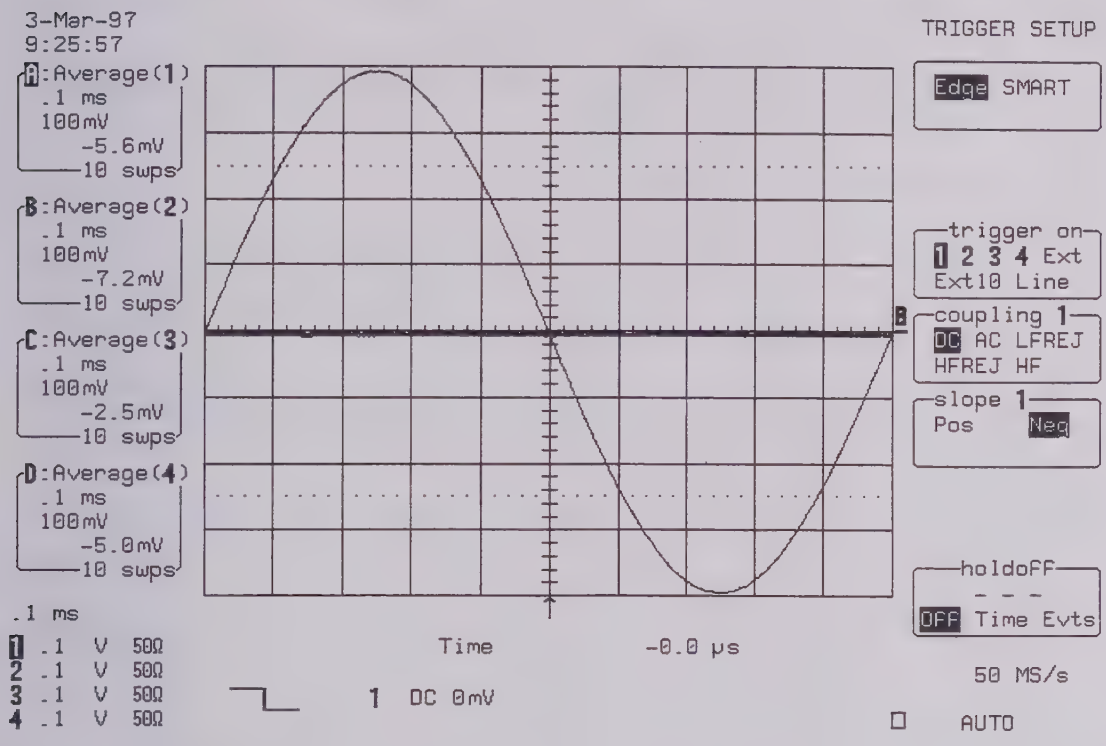
Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input Coupling	:	**DC 50Ω** on all 4 Channels
Input gain	:	**100 mV/div.** on all 4 Channels
Input offset	:	**0 mV** on all 4 Channels (use show status to verify)
Trigger setup	:	**Edge**
Trigger on	:	**1**
Slope 1	:	**Pos**
Coupling	:	**DC**
Mode	:	**Auto**
Set Trigger level	:	**DC 0.0 mV**
Pre-Trigger Delay	:	**50 %**
Timebase	:	**0.1 msec/div.**
Record up to	:	**50 k samples**
Channels Trace OFF		**Channel 1, Channel 2, Channel 3 & Channel 4**
Zoom+Math Trace ON		**A, B, C & D**
Select Math Setup		
For Math	:	**Use at most 5000 points**
Redefine A, B, C, D		**Channel 1, Channel 2, Channel 3 & Channel 4**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg. Type	:	**Summed**
For	:	**10 sweeps**

- Set the output of the LeCroy LW420 or equivalent audio frequency signal generator to **1 kHz.**
- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable and adjust the sine wave output amplitude to get **8 divisions peak to peak .**
- Select Cursors/Measure : **Cursors, Time, Absolute**
- Use the "cursor position" knob, to move the **Time marker** at 0.0 µs



- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 18 the **level** readout displayed below 100 mV in the icon **1,** at top left.
- Compare the test results to the corresponding limit in the test record.
- Set Trigger Slope 1 : **Neg**

- Acquire 10 sweeps and record in Table 18 the **level** readout displayed below 100 mV in the icon **1,** at top left.



b. HFREJ Coupling

- Set Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1,** at top left.
- Set Trigger Slope 1 : **Pos**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1,** at top left.
- Repeat steps 4.10.2.a. and 4.10.2.b. for all input channels, substituting channel controls (DC, HFREJ, Pos, Neg) and input connector.
  Recall **534P044.PNL** for Channel 2, **534P045.PNL** for Channel 3, **534P046.PNL** for Channel 4, or select **Trigger on** the Channel under test.
  The **Trigger level** is displayed in either the icon **2**, **3** or **4**
- Record the measurements in Table 18 & 19 and compare the test results to the corresponding limits in the test record.

4.10.3 Channel Trigger at +3 Divisions Threshold

a. DC Coupling

- Recall **534P047.PNL** or configure the DSO as shown in 4.10.2.a and for each Channel make the following change :

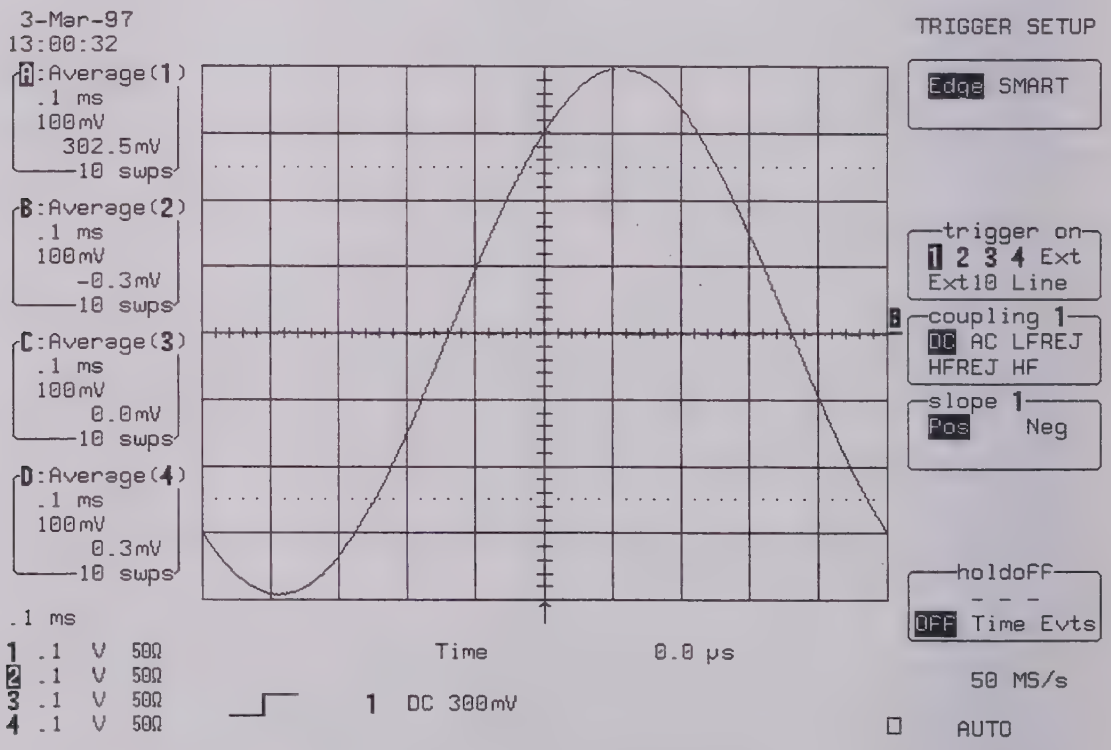
  Set Trigger level : **DC +300 mV**

- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.

- Press **Clear Sweeps**,

- Acquire 10 sweeps and record in Table 18 the **level** readout displayed below 100 mV in the icon **1,** at top left.

- Compare the test results to the corresponding limit in the test record.

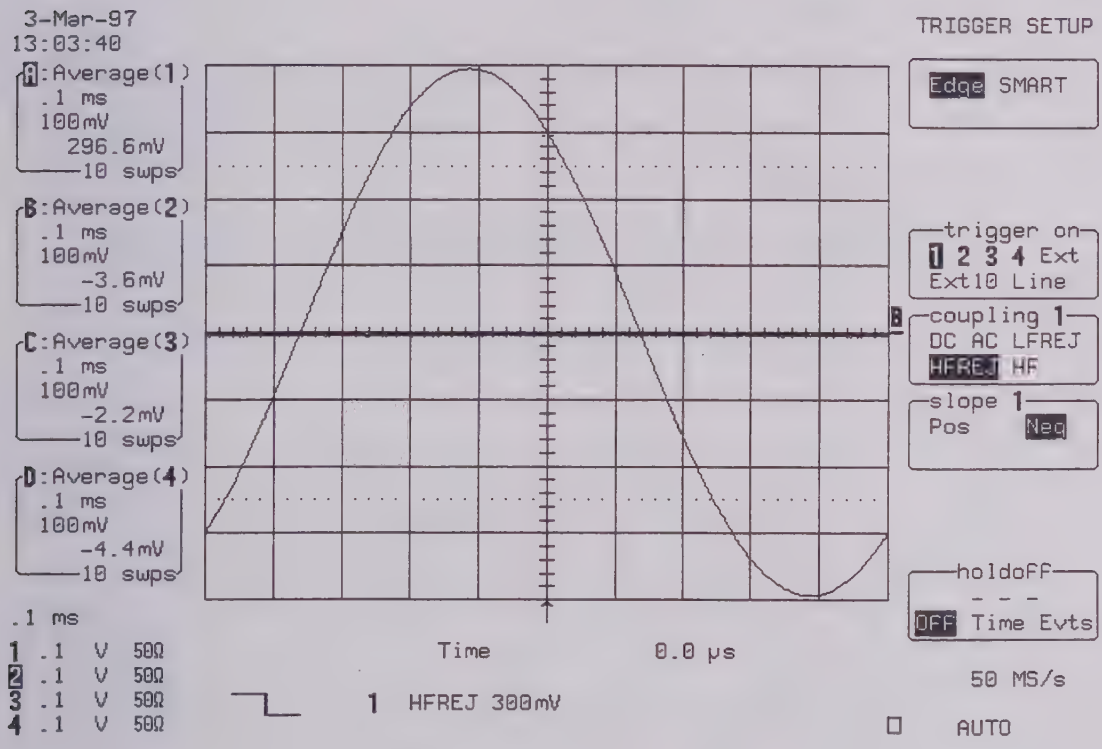


- Set Trigger Slope 1 : **Neg**

- Acquire 10 sweeps and record in Table 18 the **level** readout displayed below 100 mV in the icon **1,** at top left.

b. HFREJ Coupling

- Set Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1,** at top left.



- Set Trigger Slope 1 : **Pos**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1,** at top left.
- Repeat steps 4.10.3.a. and 4.10.3.b. for all input channels, substituting channel controls (DC, HFREJ, Pos, Neg) and input connector.
  Recall **534P048.PNL** for Channel 2, **534P049.PNL** for Channel 3, **534P050.PNL** for Channel 4, or select **Trigger on** the Channel under test.
  The **Trigger level** is displayed in either the icon **2**, **3** or **4**
- Record the measurements in Table 18 & 19 and compare the test results to the corresponding limits in the test record.

4.10.4 Channel Trigger at –3 Divisions Threshold

a. DC Coupling

- Recall **534P051.PNL** or configure the DSO as shown in 4.10.2.a and for each channel make the following change :

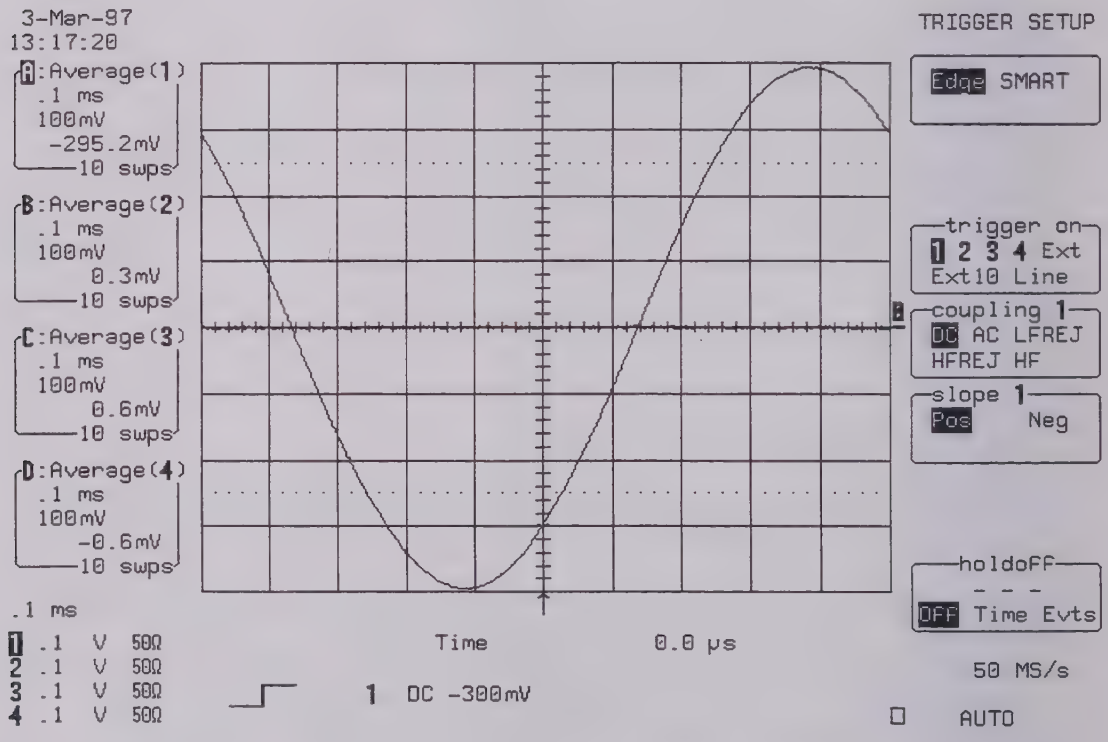
  Set Trigger level : **DC –300 mV**

- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.

- Press **Clear Sweeps**,

- Acquire 10 sweeps and record in Table 18 the **level** readout displayed below 100 mV in the icon **1,** at top left.

- Compare the test results to the corresponding limit in the test record.

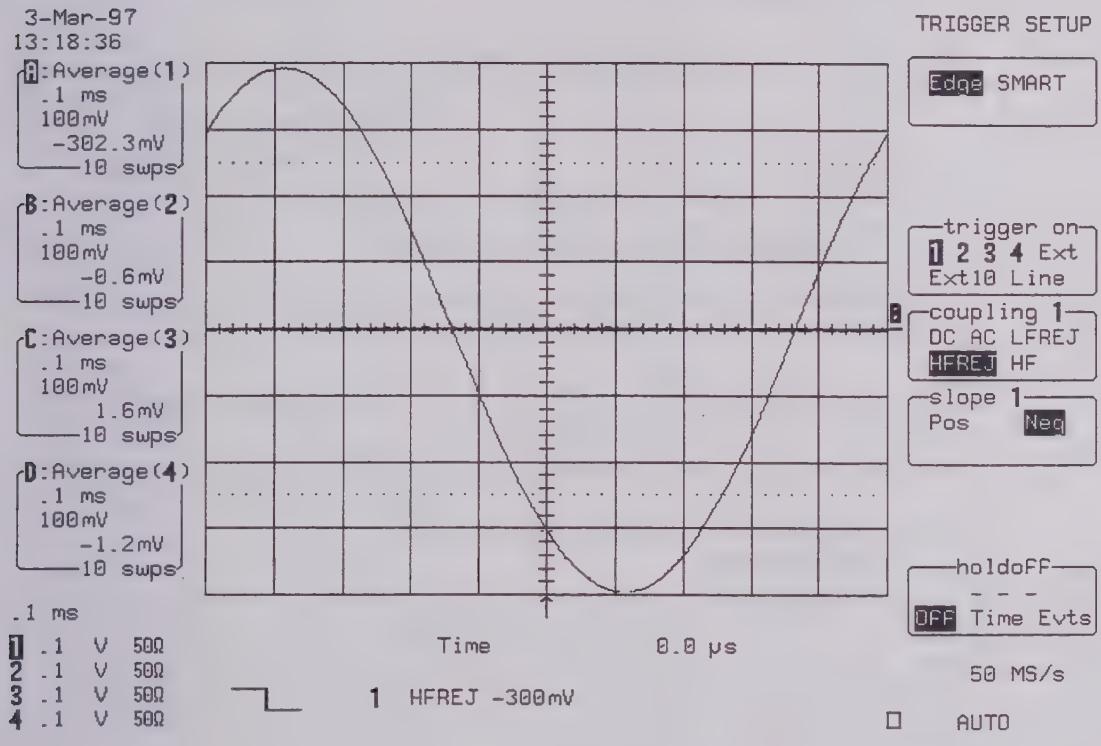


- Set Trigger Slope 1 : **Neg**

- Acquire 10 sweeps and record in Table 18 the **level** readout displayed below 100 mV in the icon **1,** at top left.

b. HFREJ Coupling

- Set Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1,** at top left.



- Set Trigger Slope 1 : **Pos**
- Acquire 10 sweeps and record in Table 19 the **level** readout displayed below 100 mV in the icon **1,** at top left.
- Repeat steps 4.10.4.a. and 4.10.4.b. for all input channels, substituting channel controls (DC, HFREJ, Pos, Neg) and input connector.
  Recall **534P052.PNL** for Channel 2, **534P053.PNL** for Channel 3, **534P054.PNL** for Channel 4, or select **Trigger on** the Channel under test.
  The **Trigger level** is displayed in either the icon **2**, **3** or **4**
- Record the measurements in Table 18 & 19 and compare the test results to the corresponding limits in the test record.

4.10.5 External Trigger at 0 Division Threshold

a. DC Coupling

- Recall **534P055.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channel Trace ON		**Channel 2**
Input Coupling	:	**DC 50Ω**
Input gain	:	**100 mV/div.**
Input offset	:	**0 mV**
Trigger setup	:	**Edge**
Trigger on	:	**Ext**
Slope Ext	:	**Pos**
Coupling Ext	:	**DC**
Set Trigger level	:	**0.0 mV**
External	:	**DC 1MΩ**
Mode	:	**Auto**
Pre-Trigger Delay	:	**50 %**
Timebase	:	**0.1 msec/div.**
Record up to	:	**50 k samples**
Channel Trace OFF		**Channel 2**
Zoom+Math Trace ON		**B**
Select Math Setup		
For Math	:	**Use at most 5000 points**
Redefine B	:	**Channel 2**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg. Type	:	**Summed**
For	:	**10 sweeps**

- Connect the test equipment as shown in Figure 4-12.
- Set the output of the LeCroy LW420 or equivalent audio frequency signal generator to **1 kHz.**
- Adjust the sine wave output amplitude to get **8 divisions peak to peak .**
- Select Cursors/Measure : **Cursors, Time, Absolute**
- Use the "cursor position" knob, to move the **Time marker** at 0.0 µs

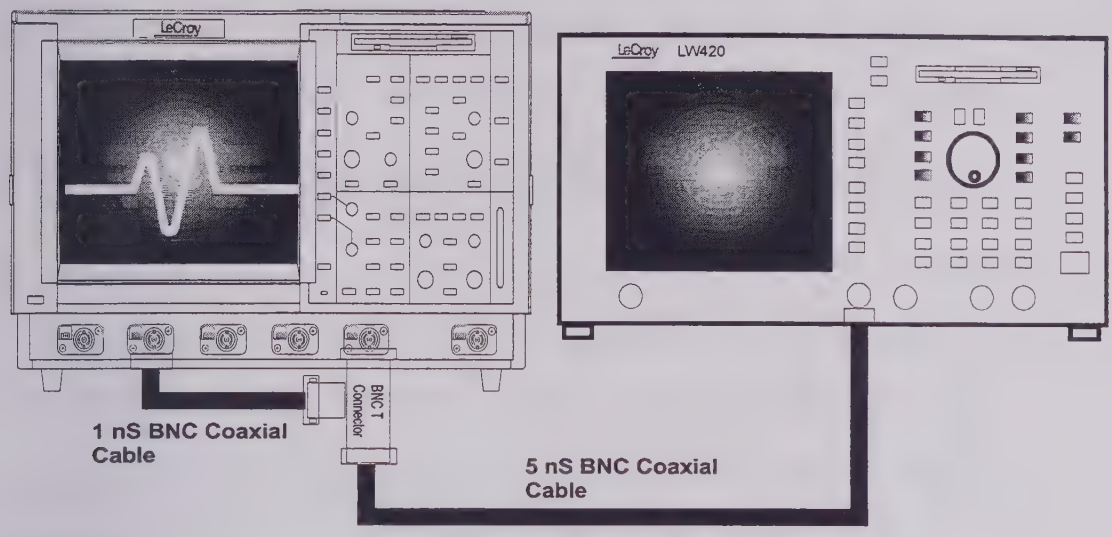
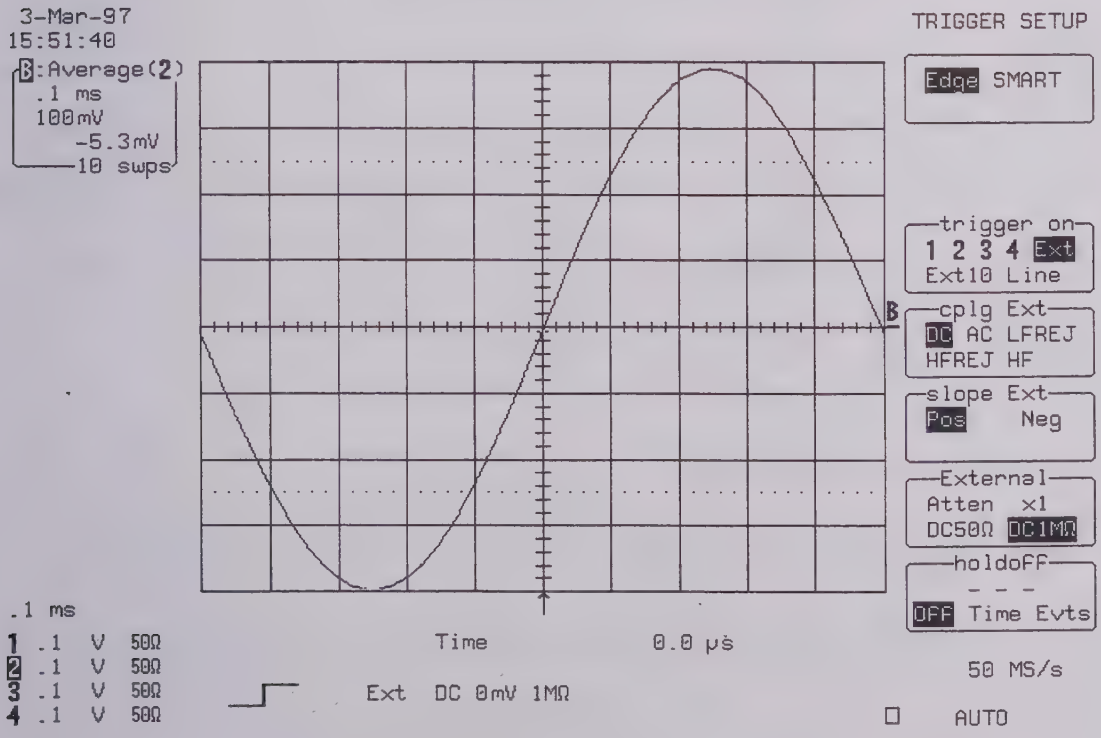


Figure 4-12 : External Trigger Equipment Setup

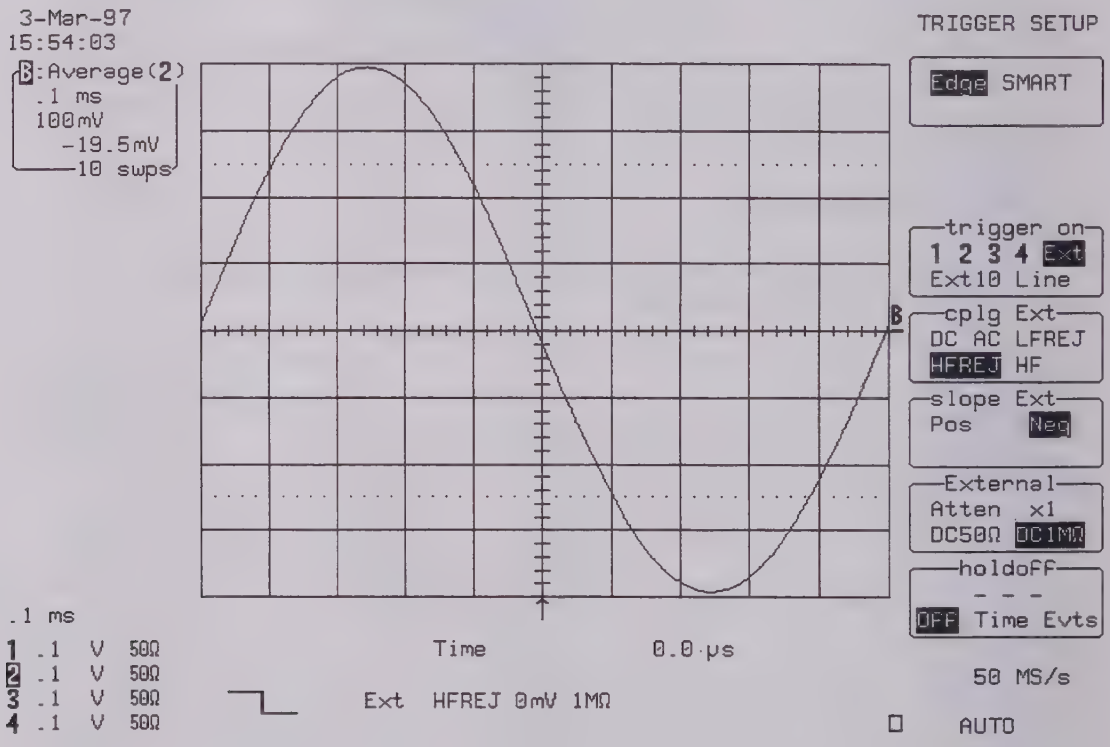
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.



- Set Trigger Slope Ext : **Neg**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.

b. HFREJ Coupling

- Set Coupling Ext : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.



- Set Trigger Slope Ext : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.

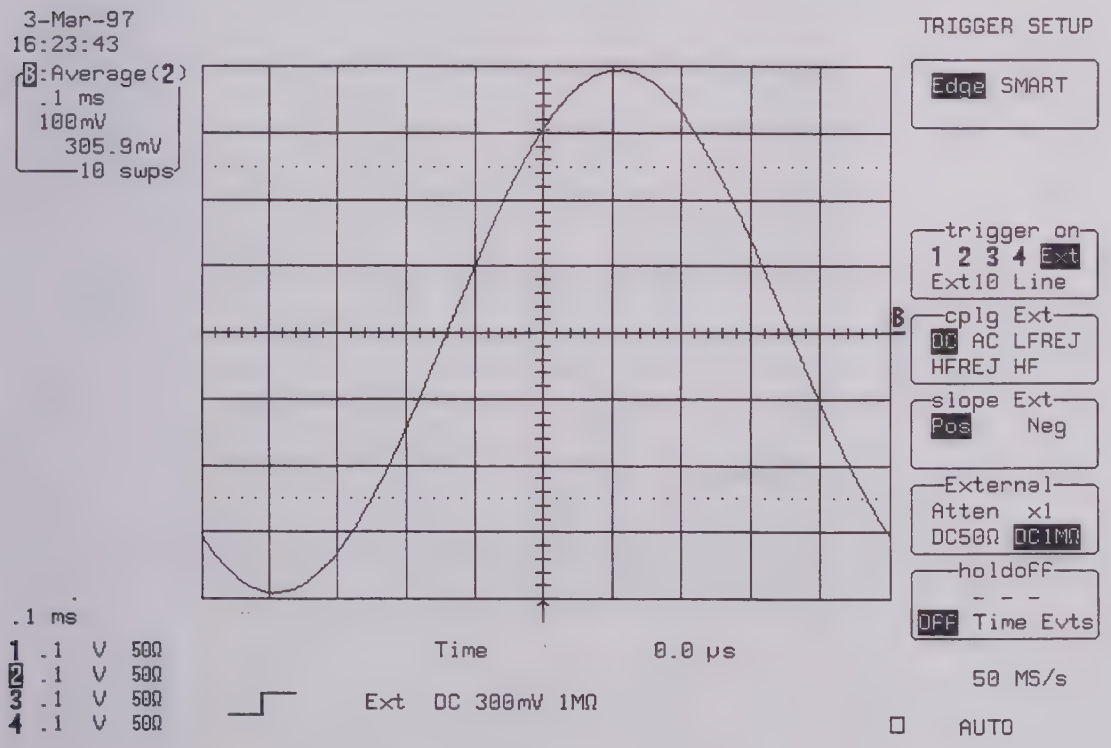
4.10.6 External Trigger at +3 Divisions Threshold

a. DC Coupling

- Recall **534P056.PNL** or configure the DSO as shown in 4.10.5.a and make the following change :

  Set Ext Trigger level : **DC +300 mV**

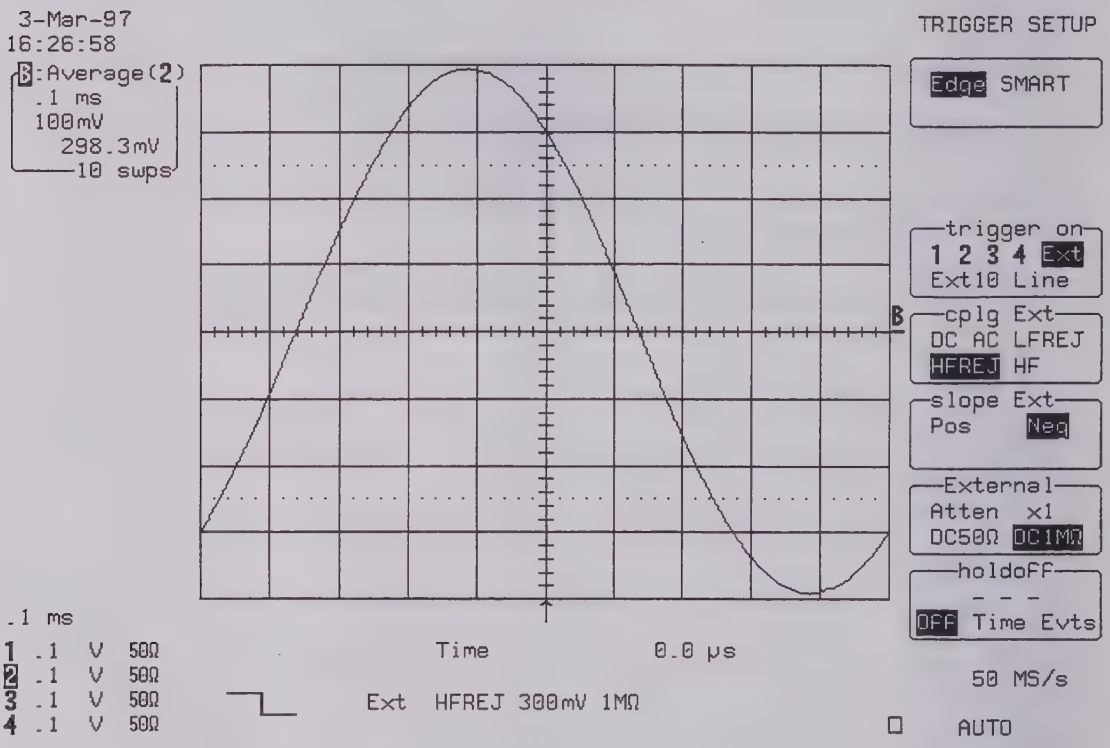
- Connect the test equipment as shown in Figure 4-12.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext : **Neg**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.

b. HFREJ Coupling

- Set Ext Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2**, at top left.



- Set Trigger Slope Ext : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2**, at top left.

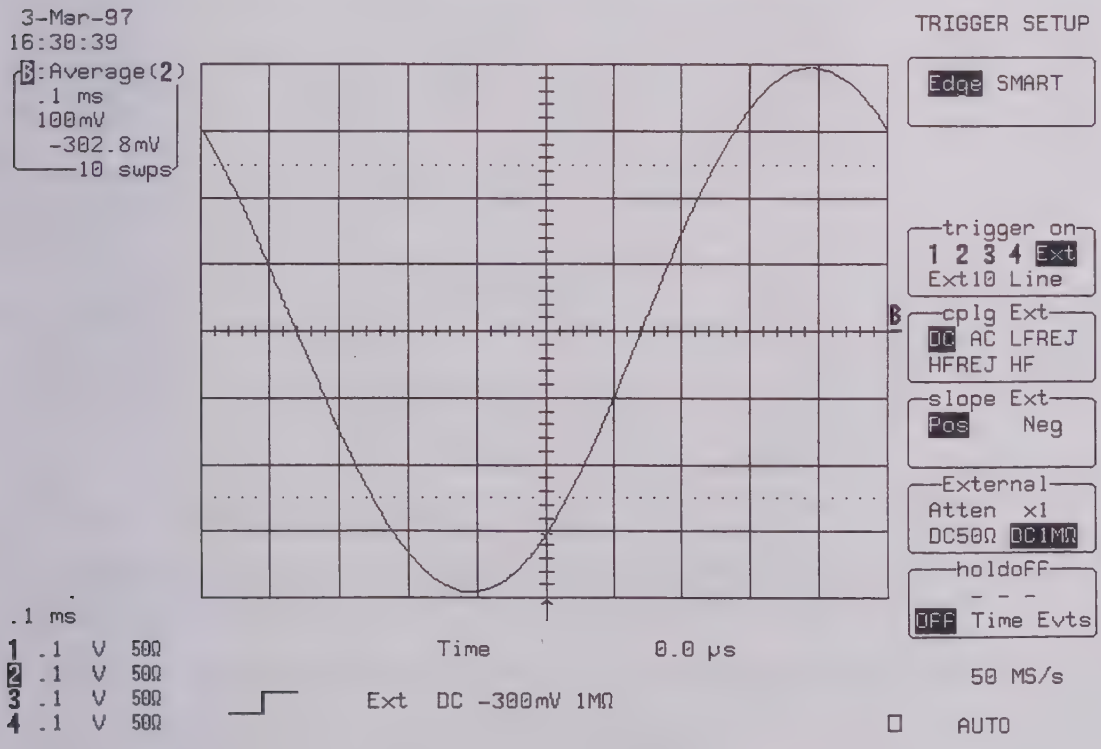
4.10.7 External Trigger at –3 Divisions Threshold

a. DC Coupling

- Recall **534P057.PNL** or configure the DSO as shown in 4.10.5.a and make the following change :

  Set Ext Trigger level : **DC –300 mV**

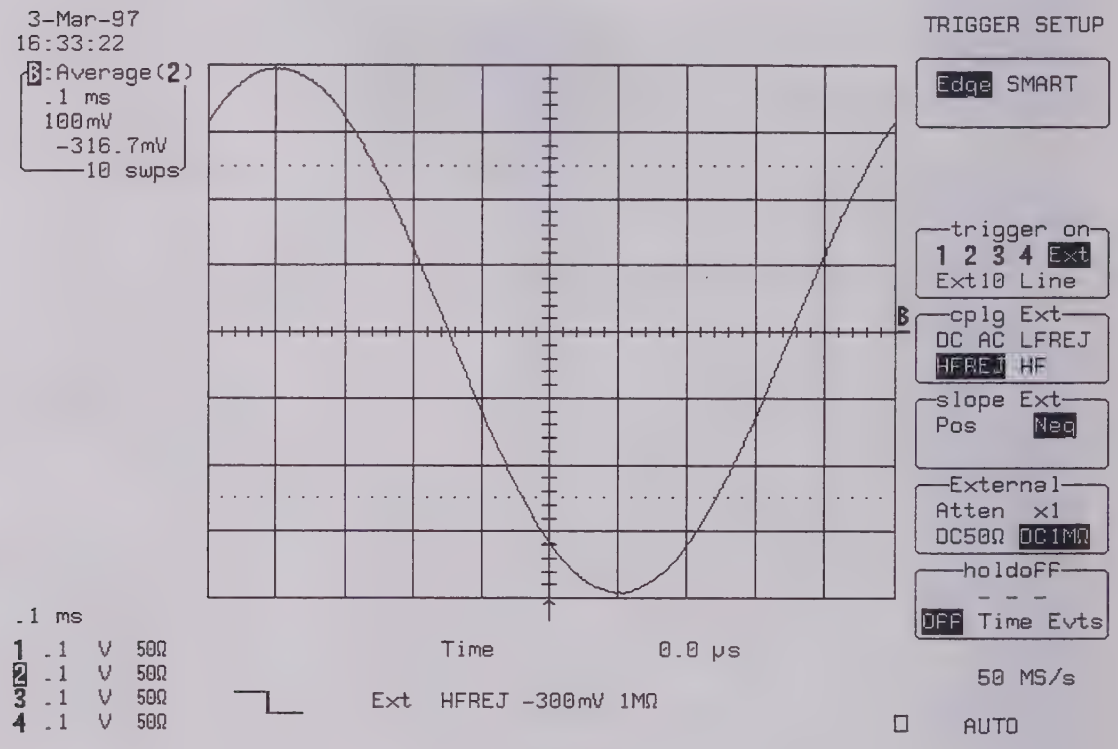
- Connect the test equipment as shown in Figure 4-12.
- Press **Clear Sweeps**.
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext : **Neg**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.

b. HFREJ Coupling

- Set Ext Coupling : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.

4.10.8 External/10 Trigger at 0 Division Threshold

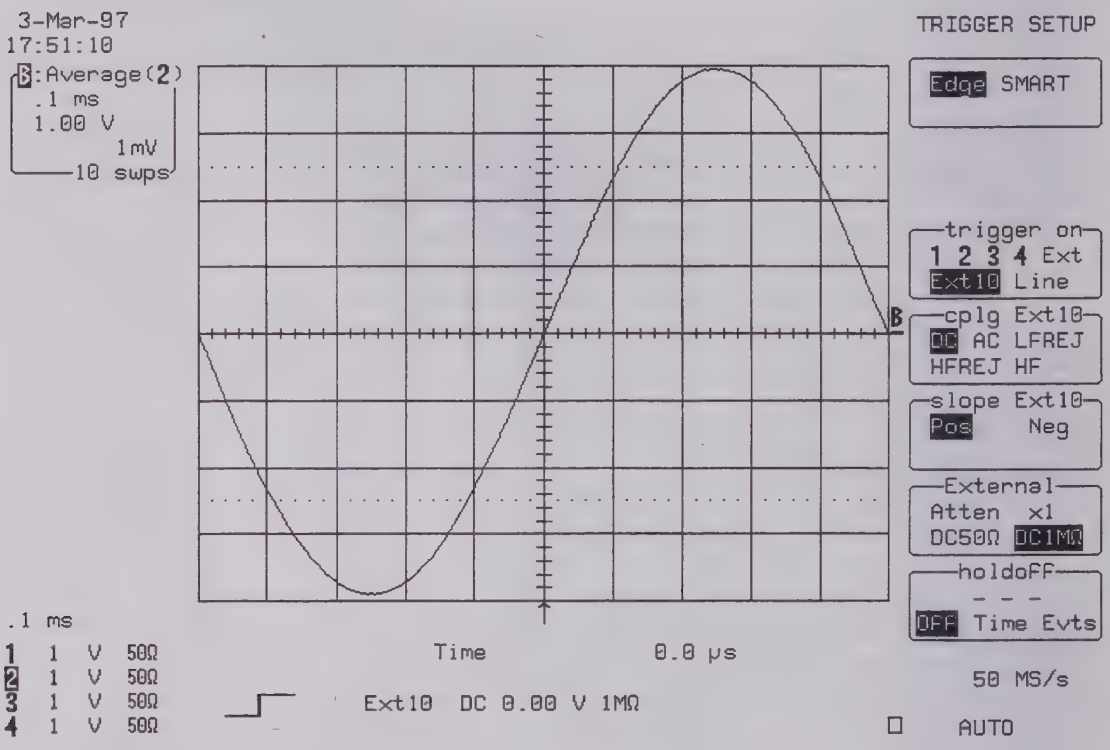
a. DC Coupling

- Recall **534P058.PNL** or configure the DSO :

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channel Trace ON		**Channel 2**
Input Coupling	:	**DC 50Ω**
Input gain	:	**1V/div**
Input offset	:	**0 mV**
Trigger setup	:	**Edge**
Trigger on	:	**Ext/10**
Slope Ext/10	:	**Pos**
Mode	:	**Auto**
Coupling	:	**DC**
Set Trigger level	:	**0.0 mV**
External	:	**DC 1MΩ**
Pre-Trigger Delay	:	**50 %**
Timebase	:	**0.1 msec/div.**
Record up to	:	**50 k samples**
Channel Trace OFF		**Channel 2**
Zoom+Math Trace ON		**B**
Select Math Setup		
For Math	:	**Use at most 5000 points**
Redefine B	:	**Channel 2**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg. Type	:	**Summed**
For	:	**10 sweeps**

- Connect the test equipment as shown in Figure 4-12.
- Set the output of the LeCroy LW420 or equivalent audio frequency signal generator to **1 kHz.**
- Adjust the sine wave output amplitude to get **8 divisions peak to peak .**
- Select Cursors/Measure : **Cursors, Time, Absolute**
- Use the "cursor position" knob, to move the **Time marker** at 0.0 μs

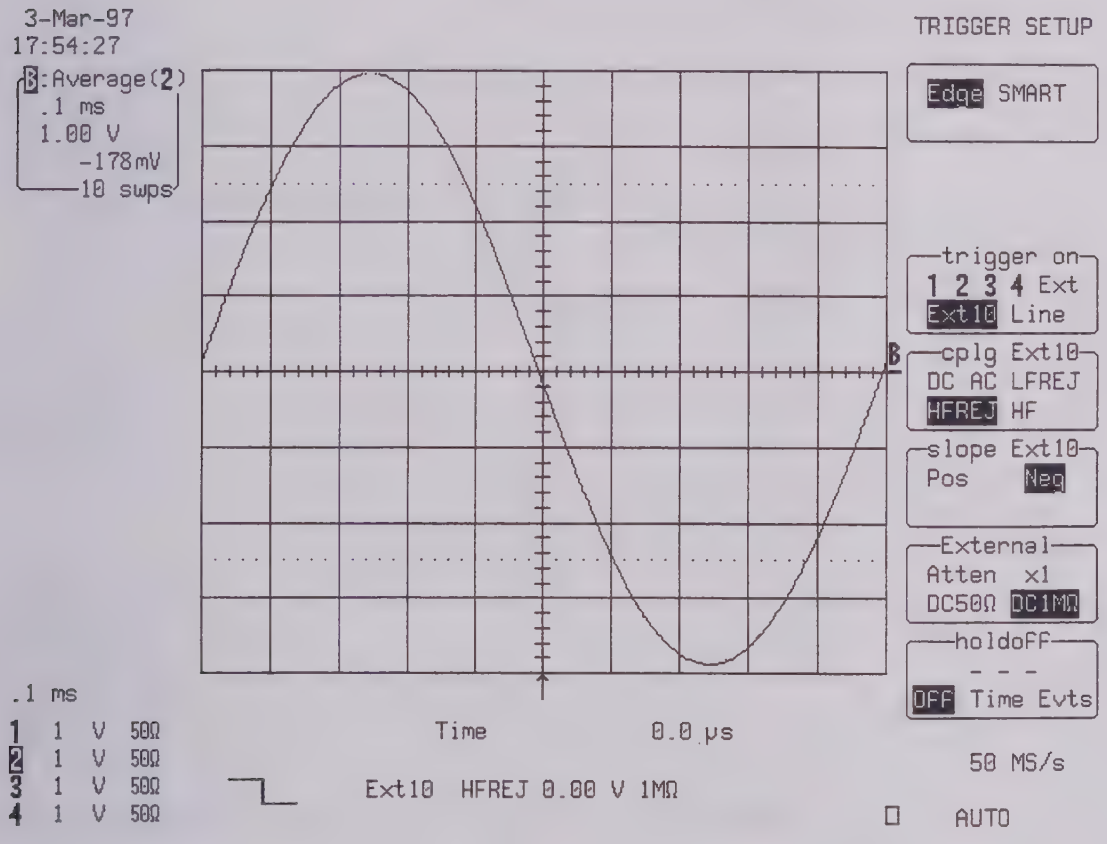
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.



- Set Trigger Slope Ext/10 : **Neg**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.

b. HFREJ Coupling

- Set Coupling Ext/10 : **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.



- Set Trigger Slope Ext/10 : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.

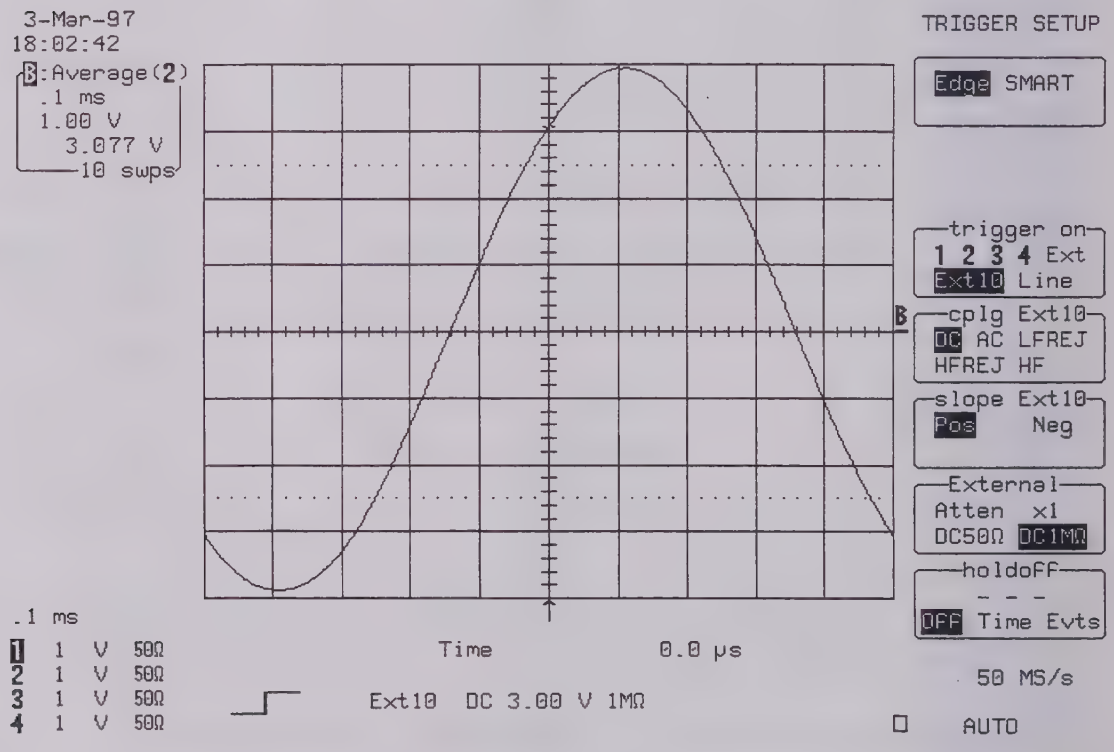
4.10.9 External/10 Trigger at +3 Divisions Threshold

a. DC Coupling

- Recall **534P059.PNL** or configure the DSO as shown in 4.10.8.a and make the following change :

  Set Ext/10 Trigger level : **DC +3 V**

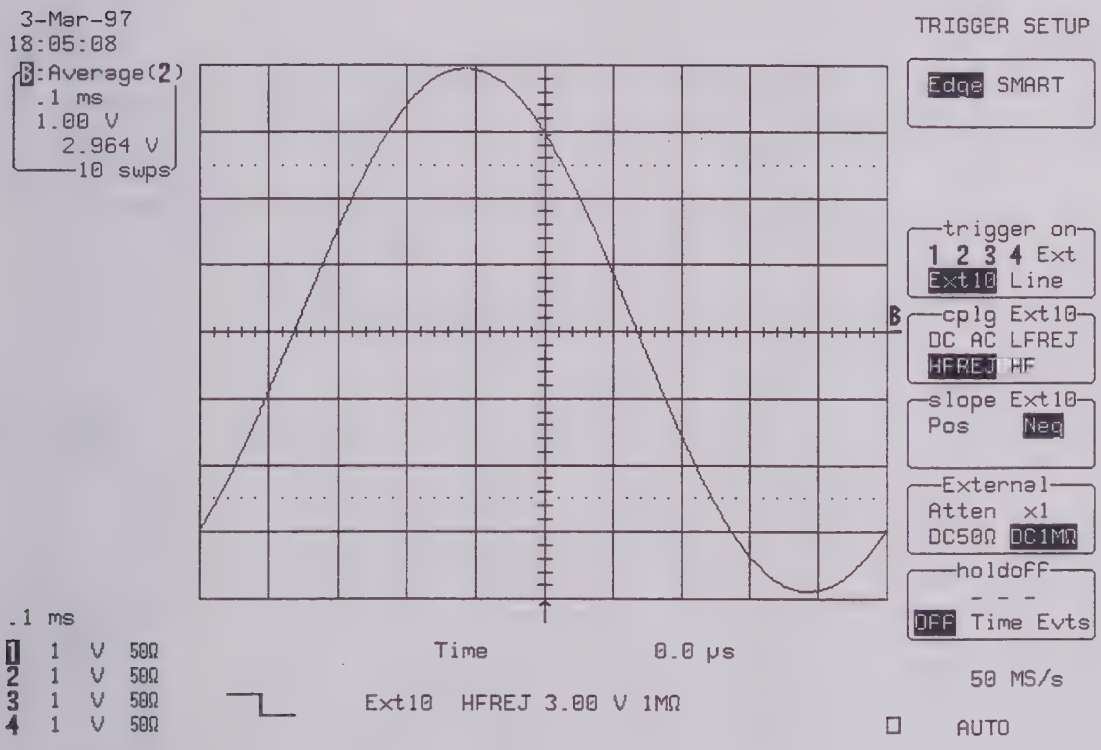
- Connect the test equipment as shown in Figure 4-12.
- Press **Clear Sweeps**,
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext/10: **Neg**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.

b. HFREJ Coupling

- Set Ext/10 Coupling: **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.



- Set Trigger Slope Ext/10 : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.

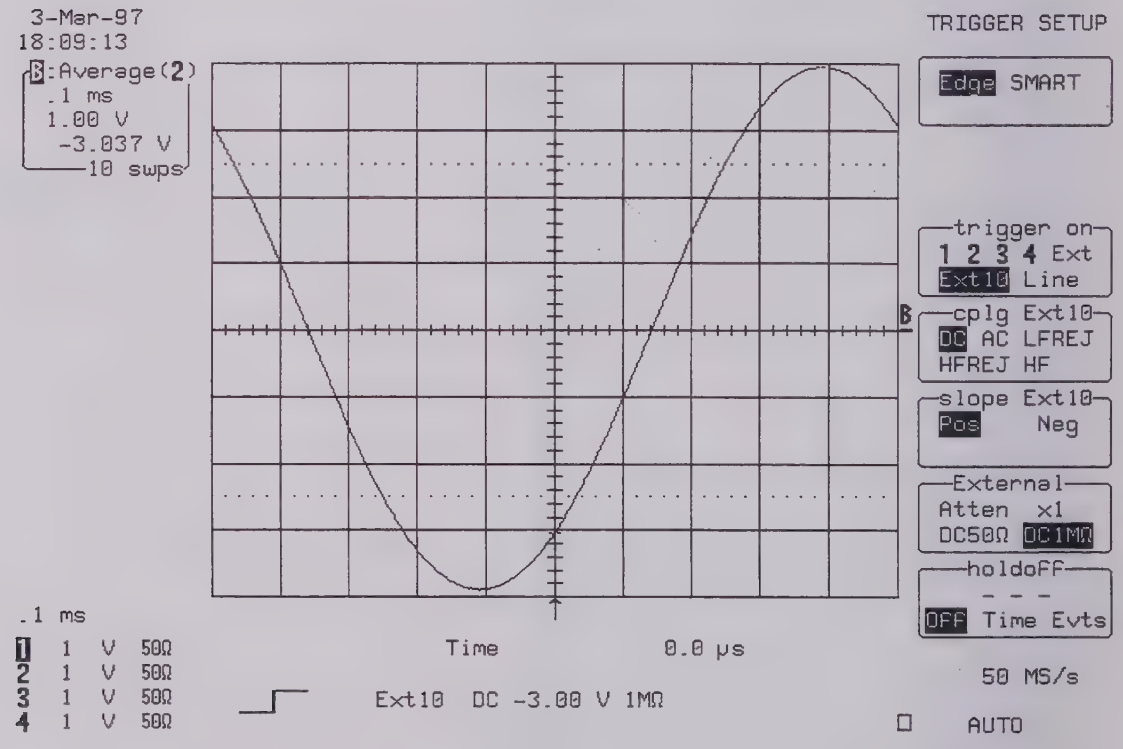
4.10.10 External/10 Trigger at –3 Divisions Threshold

a. DC Coupling

- Recall **534P060.PNL** or configure the DSO as shown in 4.10.5.a and make the following change :

  Set Ext/10 Trigger level : **DC –3 V**

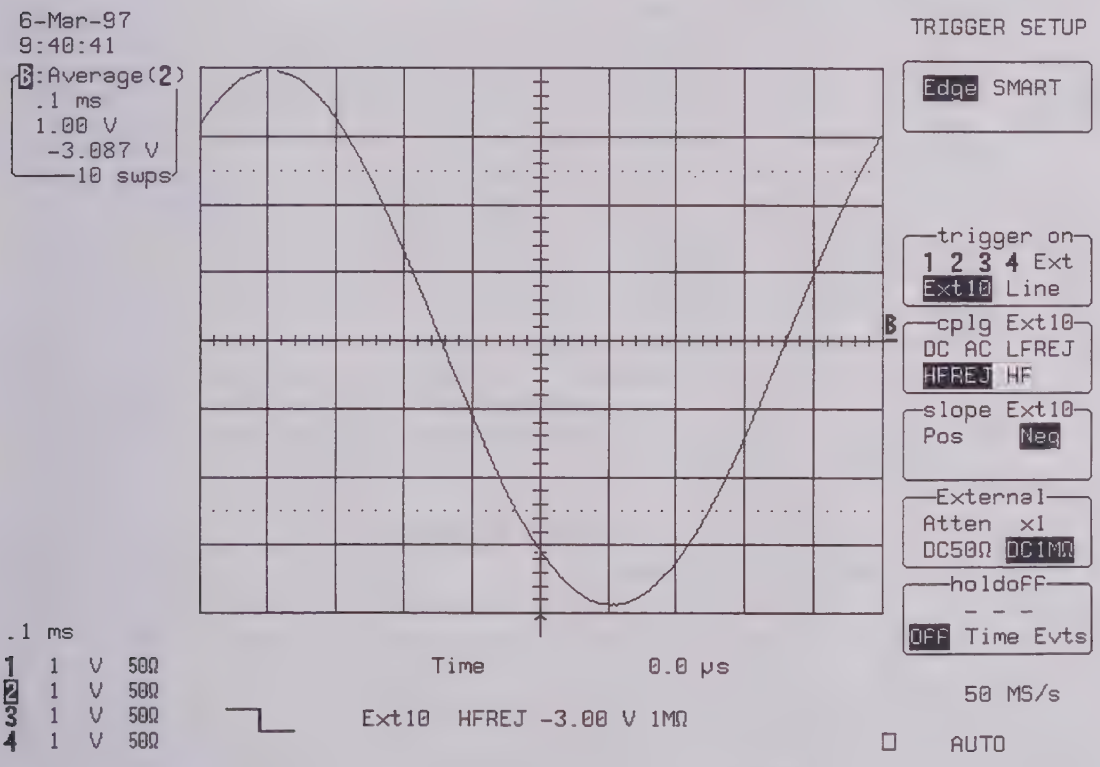
- Connect the test equipment as shown in Figure 4-12.
- Press **Clear Sweeps**.
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext/10: **Neg**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.

b. HFREJ Coupling

- Set Ext/10 Coupling: **HFREJ**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.



- Set Trigger Slope Ext/10 : **Pos**
- Acquire 10 sweeps and record in Table 20 the **level** readout displayed below 100 mV in the icon **2,** at top left.
- Compare the test results to the corresponding limit in the test record.

4.11 Smart Trigger

4.11.1 Trigger on Pulse Width 10 nsec

a. Pulse Width < 10 nsec

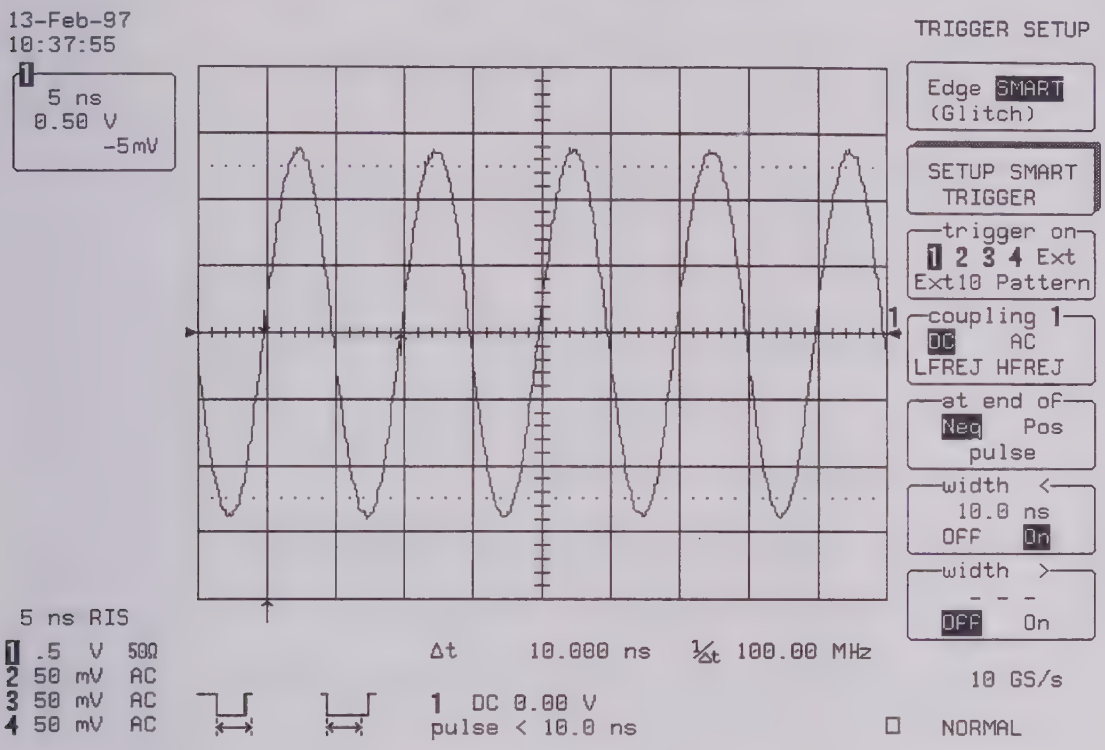
- Recall **534P061.PNL** or configure the DSO

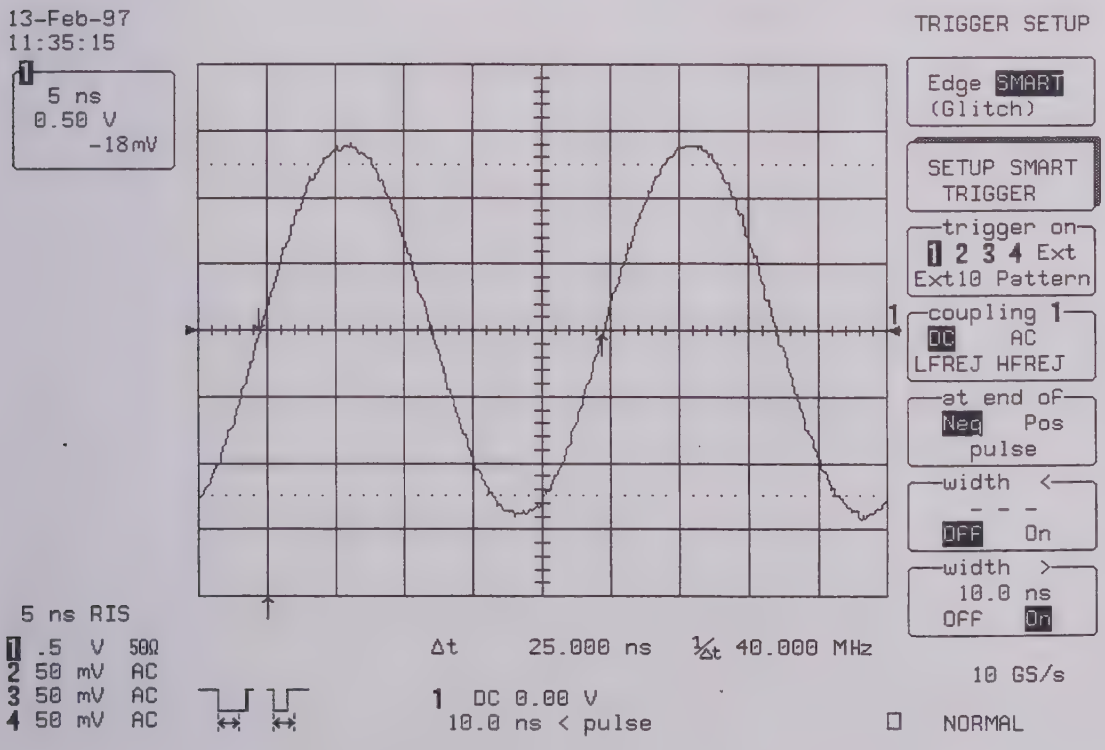
Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels trace ON		**Channel 1**
Input coupling	:	**DC 50Ω**
Input gain	:	**.5 V/div.**
Input offset	:	**0 mV**
Trigger setup	:	**Smart**
Setup Smart Trigger		**Glitch**
Trigger on	:	**1**
At the end of	:	**Neg.**
Width < 10 nsec	:	**On**
Width > 10 nsec	:	**Off**
Trigger mode	:	**Norm**
Timebase	:	**5 nsec/div.**

- Connect the **RF output** of the HP8648B generator through a 5ns 50 Ohm BNC coaxial cable into Channel 1.
- Set the generator frequency to **100 MHz**. Adjust the generator output amplitude to get **5 divisions peak to peak .**
- Check that the scope Triggers. Record the test result in Table 21.
- Set Width < 10 nsec **Off** and Width > 10 nsec **ON**
- Check that the scope **doesn't trigger :** slow trigger and no flashes in box next to normal. Record the test result in Table 21.

b. Pulse Width > 10 nsec

- Set the generator frequency to **40 MHz**.
- Set Width < 10 nsec **Off** and Width > 10 nsec **ON**
- Check that the scope Triggers. Record the test result in Table 21.
- Set Width < 10 nsec **On** and Width > 10 nsec **Off**
- Check that the scope **doesn't trigger :** slow trigger and no flashes in box . Record the test result in Table 21.


13-Feb-97
10:37:55
1
5 ns
0.50 V
-5mV
TRIGGER SETUP
Edge SMART
(Glitch)
SETUP SMART
TRIGGER
trigger on
1 2 3 4 Ext
Ext10 Pattern
coupling 1
DC AC
LFREJ HFREJ
at end of
Neg Pos
pulse
width <
10.0 ns
OFF On
width >
- - -
OFF On
5 ns RIS
1 .5 V 50Ω
2 50 mV AC
3 50 mV AC
4 50 mV AC
Δt 10.000 ns 1/Δt 100.00 MHz
1 DC 0.00 V
pulse < 10.0 ns
10 GS/s
NORMAL


13-Feb-97
11:35:15
1
5 ns
0.50 V
-18mV
TRIGGER SETUP
Edge SMART
(Glitch)
SETUP SMART
TRIGGER
trigger on
1 2 3 4 Ext
Ext10 Pattern
coupling 1
DC AC
LFREJ HFREJ
at end of
Neg Pos
pulse
width <
- - -
OFF On
width >
10.0 ns
OFF On
5 ns RIS
1 .5 V 50Ω
2 50 mV AC
3 50 mV AC
4 50 mV AC
Δt 25.000 ns 1/Δt 40.000 MHz
1 DC 0.00 V
10.0 ns < pulse
10 GS/s
NORMAL

4.11.2 Trigger on Pulse Width 100 nsec

a. Pulse Width < 100 nsec

- Recall **534P062.PNL** or configure the DSO as shown in 4.11.1.a and make the following changes :

  Width < 100 nsec : **On**

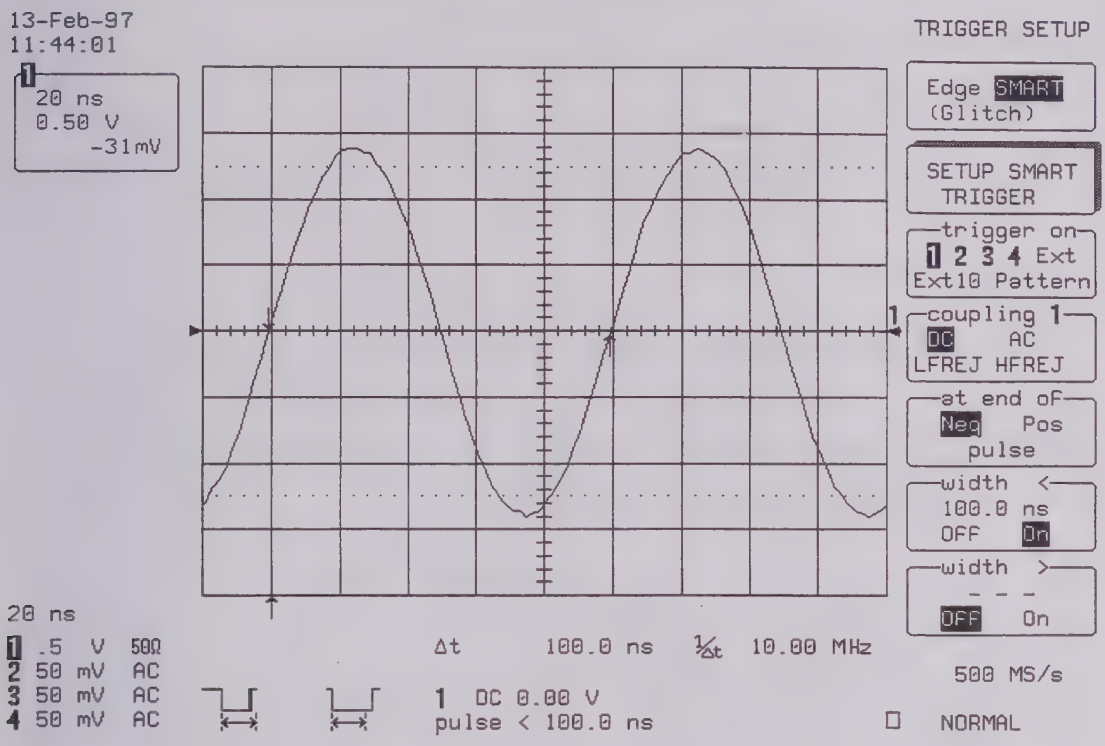
  Width > 100 nsec **:** **Off**

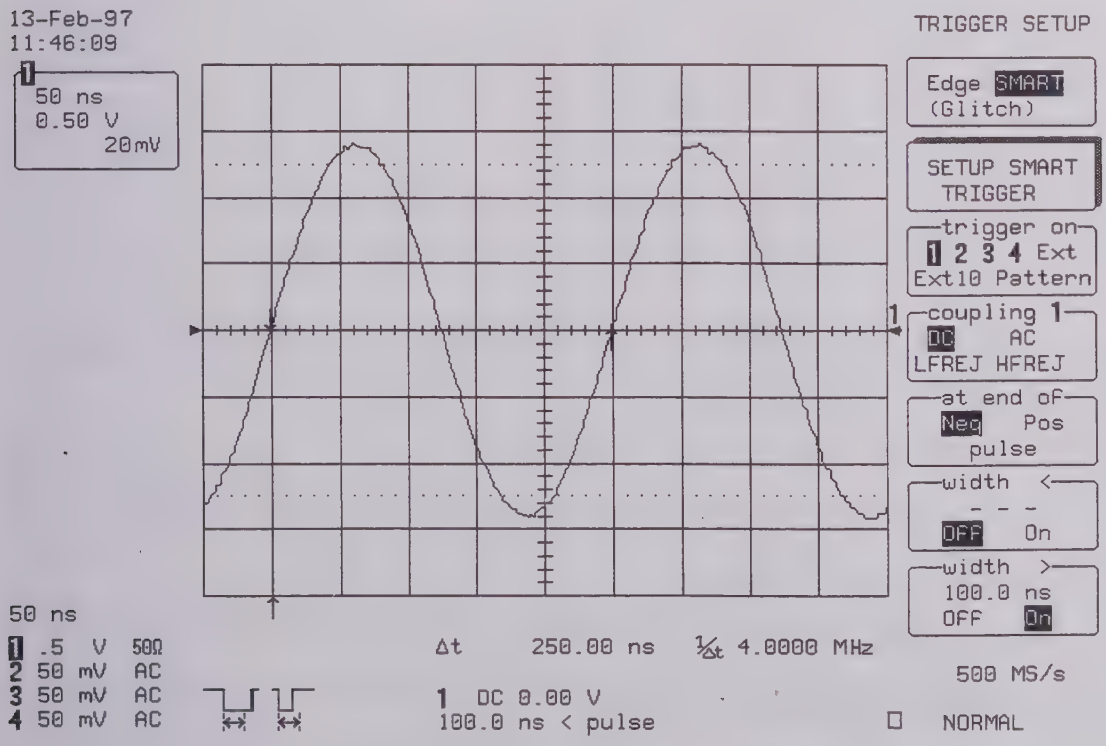
  Timebase : **20 nsec/div.**

- Set the generator frequency to **10 MHz**.
- Check that the scope Triggers. Record the test result in Table 21.
- Set Width < 100 nsec **Off** and Width > 100 nsec **ON**
- Check that the scope **doesn't trigger :** slow trigger and no flashes in box next to normal. Record the test result in Table 21.

b. Pulse Width > 100 nsec

- Set the generator frequency to **4 MHz**.
- Timebase : **50 nsec/div.**
- Set Width < 100 nsec **Off** and Width > 100 nsec **ON**
- Check that the scope Triggers. Record the test result in Table 21.
- Set Width < 100 nsec **On** and Width > 100 nsec **Off**
- Check that the scope **doesn't trigger :** slow trigger and no flashes in box. Record the test result in Table 21.


13-Feb-97
11:44:01
1
20 ns
0.50 V
-31mV
TRIGGER SETUP
Edge SMART
(Glitch)
SETUP SMART
TRIGGER
trigger on
1 2 3 4 Ext
Ext10 Pattern
coupling 1
DC AC
LFREJ HFREJ
at end of
Neg Pos
pulse
width <
100.0 ns
OFF On
width >
- - -
OFF On
20 ns
1 .5 V 50Ω
2 50 mV AC
3 50 mV AC
4 50 mV AC
Δt 100.0 ns 1/Δt 10.00 MHz
500 MS/s
1 DC 0.00 V
pulse < 100.0 ns
NORMAL


13-Feb-97
11:46:09
1
50 ns
0.50 V
20mV
TRIGGER SETUP
Edge SMART
(Glitch)
SETUP SMART
TRIGGER
trigger on
1 2 3 4 Ext
Ext10 Pattern
coupling 1
DC AC
LFREJ HFREJ
at end of
Neg Pos
pulse
width <
- - -
OFF On
width >
100.0 ns
OFF On
50 ns
1 .5 V 50Ω
2 50 mV AC
3 50 mV AC
4 50 mV AC
Δt 250.00 ns 1/Δt 4.0000 MHz
500 MS/s
1 DC 0.00 V
100.0 ns < pulse
NORMAL

4.12 Time Base Accuracy

4.12.1 Description

An external sine wave generator of **1 MHz** with a frequency accuracy better than 1 PPM is used.

Specifications

500 MHz clock : accuracy : ≤ ±**0.001 %** **or** ≤ ±**10 PPM**

4.12.2 500 MHz Clock Verification Procedure

- Recall **534P063.PNL** or configure the DSO

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels trace ON		**Channel 1**
Input coupling	:	**DC 50Ω**
Input gain	:	**.5 V/div.**
Input offset	:	**0 mV**
Trigger setup	:	**Edge**
Trigger on	:	**1**
Coupling 1	:	**DC**
Slope 1	:	**Pos**
Level 1	:	**0.5 V**
Trigger mode	:	**Norm**
Delay	:	**0 %**
Timebase	:	**.5 µsec/div.**
Channel use	:	**4**
Record up to	:	**50 k**

- Connect the **RF output** of the HP8648B generator through a 5ns 50 Ohm BNC coaxial cable into Channel 1.
- Set the generator frequency to **1 MHz**.
- Adjust the generator output amplitude to get **5 divisions peak to peak .**
- Store Channel 1 in Memory 1
- Recall **534P064.PNL** or make the following change :
- Set Post-trigger delay to **5.00 msec**
- Recall Memory **1 to A**

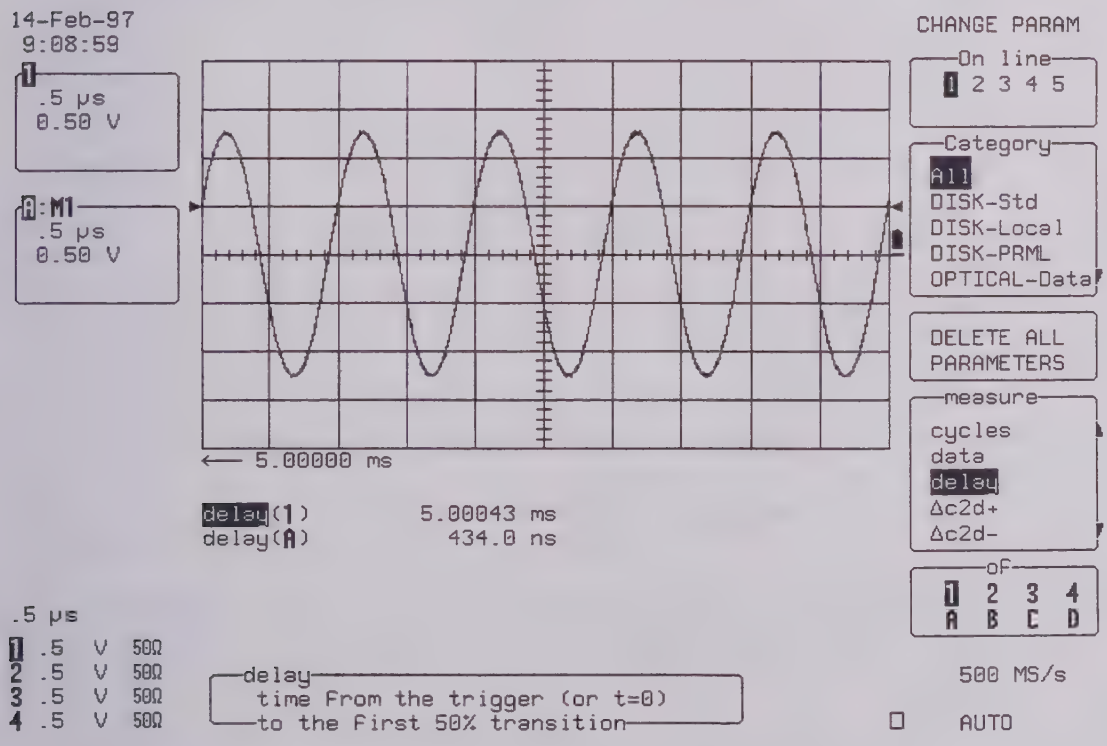
- Press : **Cursors/Measure**
- Measure : **Parameters**
- Mode : **Custom**
- Statistics : **Off**

- Change parameters

- On line 1 : **Delay of 1**
- On line 2 : **Delay of A**

- Check that the displayed Channel 1 trace is **aligned** with the sine wave from memory 1.

- This allows the accuracy of the time base clock to be checked **5000 periods** after the trigger point. A difference of ±**0.05** µ**sec** corresponds to ±**10 PPM**.



- Calculate the Difference **{[delay(A) - delay(1)]+ 5 msec}.**

- Record the test result in Table 22, and compare it to the limit in the test record.

4.13 Overshoot and Rise time (10 % - 90 %)

Specifications

DC 50Ω, 50 mV/div., : overshoot < 20 %, rise time < 0.5 ns
DC 1MΩ, 100 mV/div., : rise time < 1.5 ns

a. DC 50Ω

- Recall **534P065.PNL** or configure the DSO

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels trace ON		**Channel 1**
Input coupling	:	**DC 50Ω** on all 4 Channels
Input gain	:	**0.1 V/div.** on all 4 Channels
Input offset	:	**–250 mV** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**1**
Coupling 1	:	**DC**
Slope 1	:	**Pos**
Level 1	:	**250 mV**
Trigger mode	:	**Norm**
Delay	:	**30 % Pre-Trigger**
Timebase	:	**1 nsec/div.**
Channel use	:	**4**
Record up to	:	**50 k**
Turn on trace	:	**A**
Select Math Setup		
For Math	:	**Use at most 1000 points**
Use Math ?	:	**Yes**
Math Type	:	**Average**
Avg Type	:	**Summed**
Of	:	**Channel 1**
Sweeps	:	**100**
Turn off trace	:	**Channel 1**
Cursors/Measure	:	**Parameters**
Mode	:	**Custom**
Statistics	:	**Off**
Change Parameters	:	
On displayed trace:		**A**
On line 1	:	
Measure	:	**Over + of A**
On line 2	:	
Measure	:	**Rise of A**

- Connect the fast pulse generator 4969A and PB049 power adapter, or equivalent as shown in Figure 4-13.
- Set the 4969A frequency to **1 kHz**

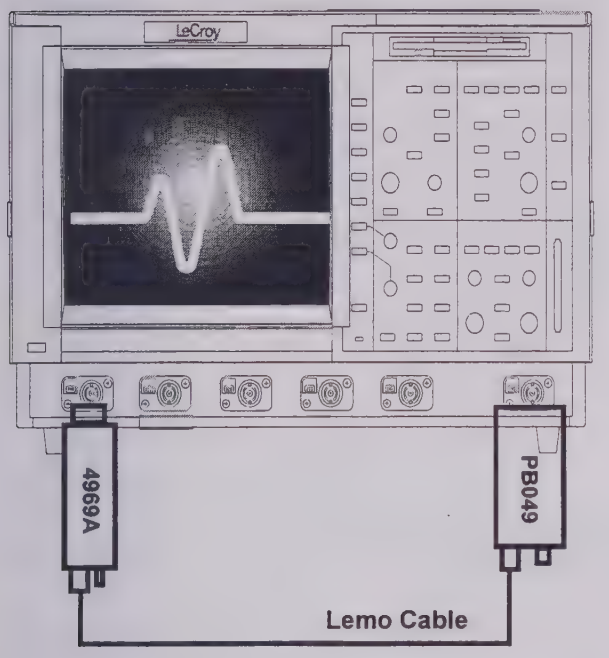
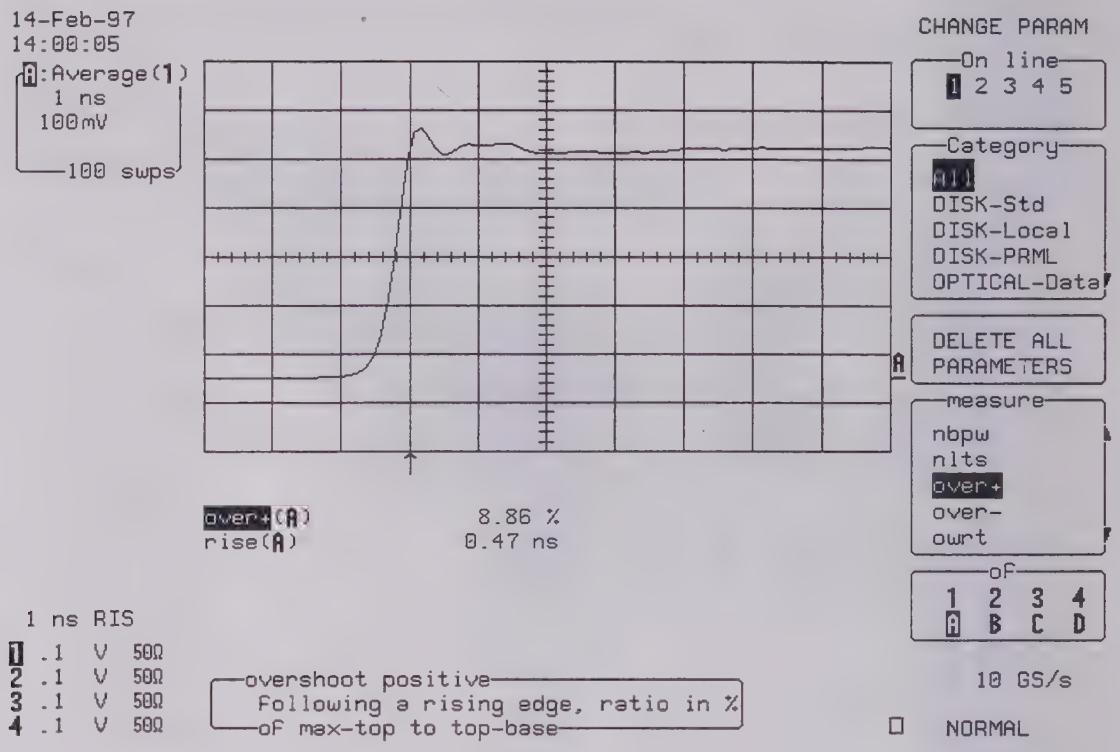


Figure 4-13 : 50 Ω Overshoot & Rise time Equipment Setup

- Press **Clear Sweep**
- After 100 sweeps record **over+(A)** and **rise(A)** measurements in Table 23.
- Repeat the DC 50Ω Overshoot and Rise time test for the other channels, substituting channel controls and input connector.
- Recall **534P066.PNL** for Channel 2, **534P067.PNL** for Channel3 **534P068.PNL** for Channel 4, or configure the DSO as shown in 4.13.a. and make the necessary changes.
- Record the test results in Table 23, and compare the results to the limits.



b. DC 1MΩ

- Recall **534P069.PNL** or configure the DSO as shown in 4.13.a. and make the following change :

  Set Input Coupling: **DC 1MΩ** on all 4 Channels
  Input gain : **50 mV/div.** on all 4 Channels
  Input offset : **–150 mV** on all 4 Channels
  Trigger Level : **75 mV**
  Timebase : **1 nsec/div.**

- Terminate the output of the 4969A Pulser with the 4962-8 adapter (50Ω to 1MΩ) as shown in Figure 4-14.

- Press **Clear Sweep**. After **100 sweeps** record **over+(A)** and **rise(A)** in Table23.

- Repeat the DC 1MΩ Overshoot and Rise time test for the other channels, substituting channel controls and input connector.

- Recall **534P070.PNL** for Channel 2, **534P071.PNL** for Channel3 **534P072.PNL** for Channel 4, or configure the DSO as shown in 4.13.a. and make the necessary changes.

- Record the test results in Table 23, and compare the results to the limits.

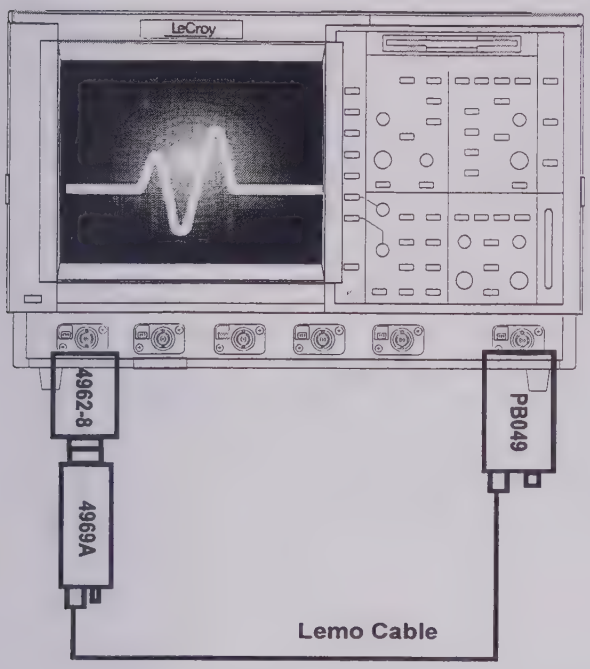
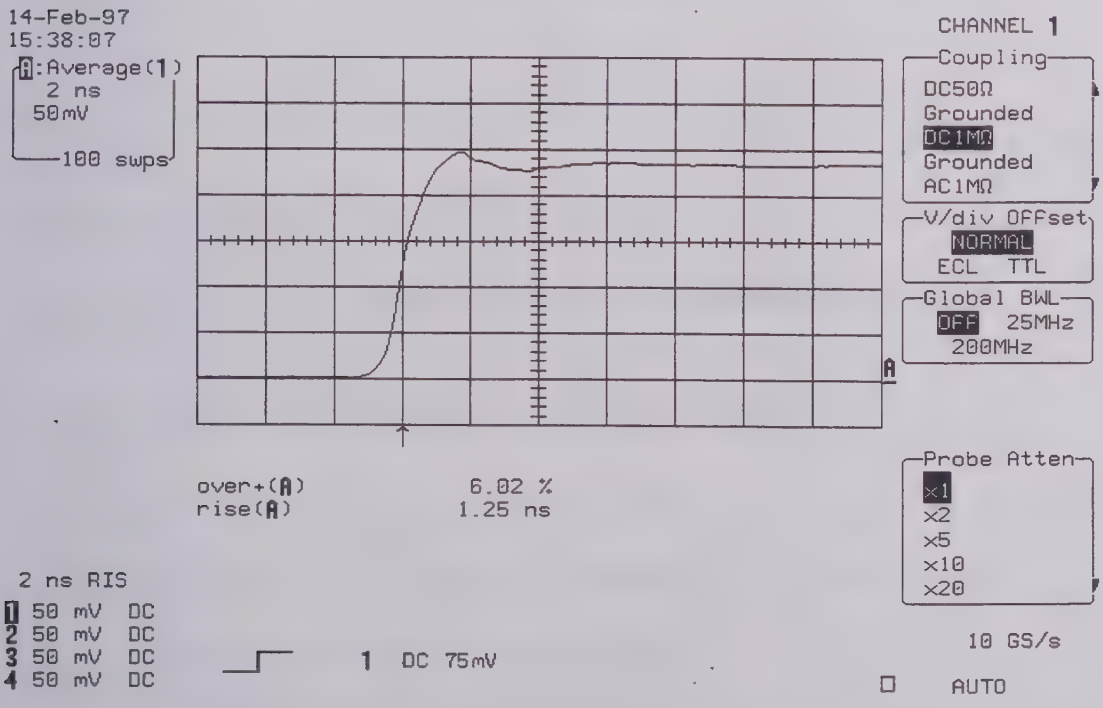


Figure 4-14 : 1MΩ Overshoot & Rise time Equipment Setup



4.14 Overload

Specifications

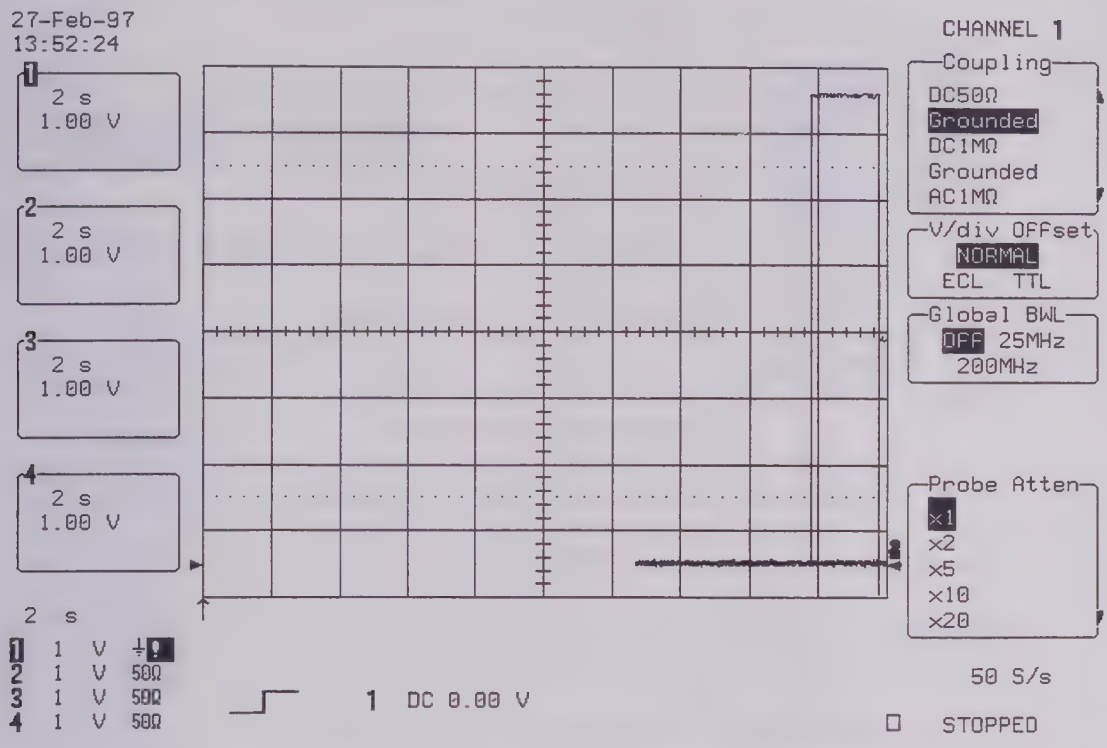
1 Watt into 50Ω : Overload Trip < 17 seconds

a. Channel Overload Trip

- Recall **534P073.PNL** or configure the DSO

Panel Setups	:	**Recall FROM DEFAULT SETUP**
Channels Trace ON		**Channel 1, Channel 2, Channel 3 & Channel 4**
Input coupling	:	**DC 50Ω** on all 4 Channels
Input gain	:	**1 V/div.** on all 4 Channels
Input offset	:	**–3.5 V** on all 4 Channels
Trigger setup	:	**Edge**
Trigger on	:	**1**
Coupling 1	:	**DC**
Slope 1	:	**Pos**
Level 1	:	**0 V**
Trigger mode	:	**Norm**
Delay	:	**zero**
Timebase	:	**2 sec/div.**
Channel use	:	**4**
Record up to	:	**1000 samples**

- Set the output of the external **DC voltage source** to **+7.07 Volt** corresponding to 1 Watt into 50Ω.
- Connect the **DC voltage reference source** through a BNC cable into Channel1.
- When the channel **overload trips** press **Stop** to halt the acquisition.
- **Measure** on the screen the **overload trip time** and record it in Table 24.
- Repeat the above tests for Channel 2, Channel 3 and Channel 4 substituting the input connector.
- Record the test results in Table 24, and compare the results to the limits.
- For all Channel **clear the overload** by selecting DC 50Ω in the Coupling menu.
- Set Timebase : **5 sec/div.**



- Set the output of the external **DC voltage source** to **+5.00 Volt** corresponding to 0.5 Watt into 50Ω.

- For all channels check that the overload doesn't trip for at least **35** seconds. Record the test result in Table 24.

b. External Overload Trip

- Recall **534P074.PNL**, or configure the DSO as shown in 4.14.a and make the following changes.

Channel Trace ON:		**Channel 2**
Input coupling	:	**DC 1MΩ**
Trigger on	:	**Ext**
Slope Ext	:	**Pos.**
External	:	**DC 50Ω**
Mode	:	**Norm**
Set Trigger level	:	**DC 0.0 mV**

- Connect the test equipment as shown in Figure 4-15.

- Set the output of the external **DC voltage source** to **+7.07 Volt**

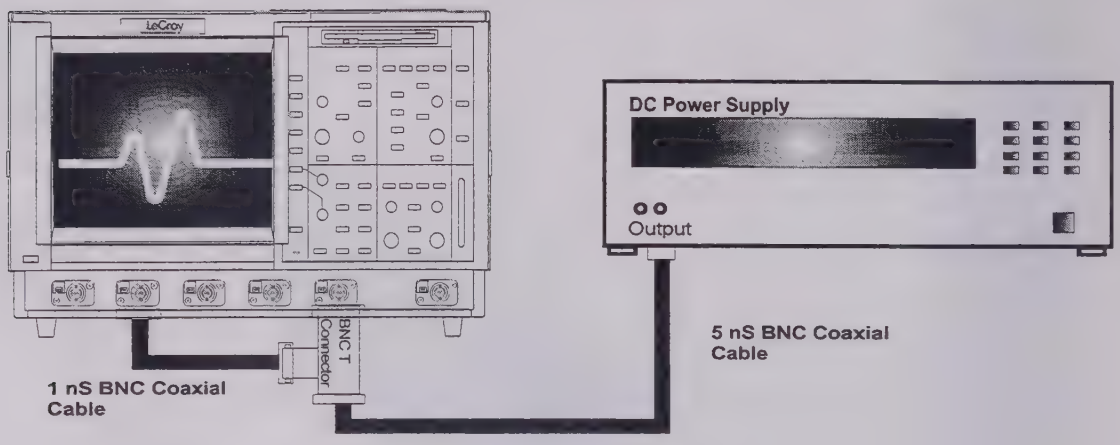
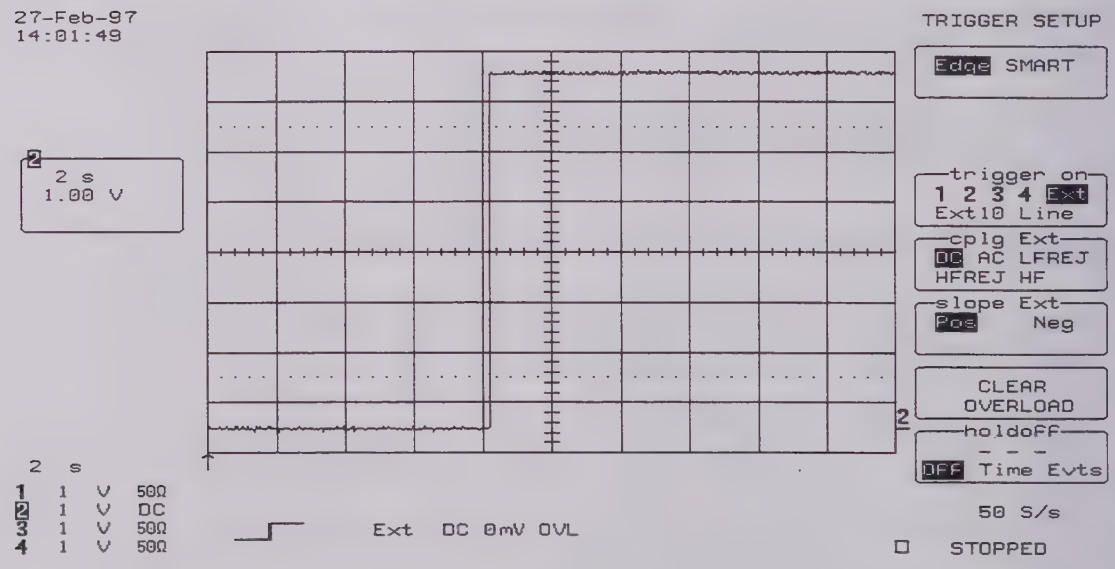


Figure 4-15 : External Overload Equipment Setup

- When the External **overload trips** press **Stop** to halt the acquisition.
- **Measure** on the screen the **overload trip time** and record it in Table 24. Compare the result to the limit in the test record.
- Press **clear overload** in the trigger setup menu.



- Set Timebase : **5 sec/div.**
- Set the output of the external **DC voltage source** to **+5.00 Volt**
- Check that the External overload doesn't trip for at least **35** seconds. Record the test result in Table 24.

LeCroy Digital Storage Oscilloscope

Performance Certificate

LC534/A Manual Performance Test Procedure Version A - February 1997

Model_____ Serial Number_____ Customer_____

Software Version_____

Inspection Date_____ Next Due_____

Temperature_____ Humidity_____%

Tested By_____ Report Number_____

Place of Inspection_____

Condition found_____ Condition Left_____

Approved By_____

Test Equipment Used

Instrument	Model	S/N	Cal Due Date
Signal Generator Radio Frequency	_____	_____	_____
Signal Generator Audio Frequency	_____	_____	_____
Voltage Generator DC Power Supply	_____	_____	_____
Step Generator Fast Pulser	_____	_____	_____
Digital Multimeter Voltmeter, Ohmmeter	_____	_____	_____

Traceable to_____

Table 1 : LC534 & LC534A Test Report

Coupling	Volts/div.	Measured Channel 1 Impedance Ω, MΩ	Measured Channel 2 Impedance Ω, MΩ	Measured Channel 3 Impedance Ω, MΩ	Measured Channel 4 Impedance Ω, MΩ	Measured External Impedance Ω, MΩ	Measured External/10 Impedance Ω, MΩ	Lower Limit Ω, MΩ	Upper Limit Ω, MΩ
DC 1MΩ	50 mV/div							0.99 MΩ	1.01 MΩ
DC 1MΩ	200 mV/div					N/A	N/A	0.99 MΩ	1.01 MΩ
AC 1MΩ	50 mV/div					N/A	N/A	1.08 MΩ	1.14 MΩ
AC 1MΩ	200 mV/div					N/A	N/A	0.98 MΩ	1.02 MΩ
DC 50Ω	50 mV/div						N/A	49.5 Ω	50.5 Ω
DC 50Ω	200 mV/div					N/A	N/A	49.5 Ω	50.5 Ω
DC 1MΩ Grounded	50 mV/div					N/A	N/A	0.98 MΩ	1.02 MΩ

Table 2 : Impedance Test Record

Coupling	Volts/div.	Measured Channel 1 Leakage mV	Measured Channel 2 Leakage mV	Measured Channel 3 Leakage mV	Measured Channel 4 Leakage mV	Measured External Leakage mV	Lower Limit mV	Upper Limit mV
DC 1MΩ	50 mV/div					N/A	–1	+1
DC 1MΩ	200 mV/div					N/A	–1	+1
DC 50Ω	50 mV/div						–1	+1
DC 50Ω	200 mV/div					N/A	–1	+1

Table 3 : Leakage Voltage Test Record

Coupling	Time/Div.	Measured Channel 1 pkpk mV	Measured Channel 2 pkpk mV	Measured Channel 3 pkpk mV	Measured Channel 4 pkpk mV	Limits mV
DC 1MΩ	20 ms					7.2
DC 1MΩ	1 ms					7.2
DC 1MΩ	50 µs					7.2
DC 1MΩ	10 µs					7.2
AC 1MΩ	10 µs					7.2
DC 50Ω	10 µs					7.2
DC 50Ω	50 µs					7.2
DC 50Ω 2 Ch Combined	5 µs	disabled			disabled	7.2
DC 50Ω 4 Ch Combined	2 µs	disabled		disabled	disabled	7.2

Table 4 : Peak to Peak Noise Test Record

Coupling	Time/Div.	Measured Channel 1 sdev mV	Measured Channel 2 sdev mV	Measured Channel 3 sdev mV	Measured Channel 4 sdev mV	Limits mV
DC 1MΩ	20 ms					0.72
DC 1MΩ	1 ms					0.72
DC 1MΩ	50 µs					0.72
DC 1MΩ	10 µs					0.72
AC 1MΩ	10 µs					0.72
DC 50Ω	10 µs					0.72
DC 50Ω	50 µs					0.72
DC 50Ω 2 Ch Combined	5 µs	disabled			disabled	0.72
DC 50Ω 4 Ch Combined	2 µs	disabled		disabled	disabled	0.72

Table 5 : RMS Noise Test Record

Coupling	Volts/div.	Measured Channel 1 Mean (A) mV	Measured Channel 2 Mean (B) mV	Measured Channel 3 Mean (C) mV	Measured Channel 4 Mean (D) mV	Lower Limit mV	Upper Limit mV
DC 1MΩ	5 mV					–2	+2
DC 1MΩ	10 mV					–1.6	+1.6
DC 1MΩ	20 mV					–3.2	+3.2
DC 1MΩ	50 mV					–8	+8
DC 1MΩ	.1 V					–16	+16
DC 1MΩ	1 V					–160	+160

Table 6 : DC 1MΩ Ground Line Test Record

Coupling	Volts/div.	Measured Channel 1 Mean (A) mV	Measured Channel 2 Mean (B) mV	Measured Channel 3 Mean (C) mV	Measured Channel 4 Mean (D) mV	Lower Limit mV	Upper Limit mV
DC 50Ω	5 mV					–2	+2
DC 50Ω	10 mV					–1.6	+1.6
DC 50Ω	20 mV					–3.2	+3.2
DC 50Ω	50 mV					–8	+8
DC 50Ω	.1 V					–16	+16
DC 50Ω	1 V					–160	+160
DC 50Ω 2 Ch Combined	.2 V	disabled			disabled	–48	+48
DC 50Ω 4 Ch Combined	.2 V	disabled		disabled	disabled	–64	+64

Table 7 : DC 50Ω Ground Line Test Record

Volts /div.	Attenuator	P S Output	Measured Channel 1 V & mV			Measured Channel 2 V & mV			Measured Channel 3 V & mV			Measured Channel 4 V & mV			Limits
			DMM 1	Mean (A)	Δ 1 Mean–DMM	DMM 2	Mean (B)	Δ 2 Mean–DMM	DMM 3	Mean (C)	Δ 3 Mean–DMM	DMM 4	Mean (D)	Δ 4 Mean–DMM	mV
5 mV	X 100	+1.5 V													±1.2
10 mV	X 100	+3.0 V													±1.6
20 mV	X 100	+6.0 V													±3.2
50 mV	X 10	+1.5V													±8
.1 V	X 10	+3.0 V													±16
1 V	X 1	+3.0 V													±160

Table 8 : DC 50Ω, Positive DC Accuracy Test Record

Volts /div.	Attenuator	P S Output	Measured Channel 1 V & mV			Measured Channel 2 V & mV			Measured Channel 3 V & mV			Measured Channel 4 V & mV			Limits
			DMM 1	Mean (A)	Δ 1 Mean–DMM	DMM 2	Mean (B)	Δ 2 Mean–DMM	DMM 3	Mean (C)	Δ 3 Mean–DMM	DMM 4	Mean (D)	Δ 4 Mean–DMM	mV
5 mV	X 100	+1.5 V													±1.2
.1 V	X 10	+3.0 V													±16
5 V	X 1	+15.0 V													±800

Table 9 : DC 1MΩ, Positive DC Accuracy Test Record

Volts /div.	Attenuator	P S Output	Measured Channel 1 V & mV			Measured Channel 2 V & mV			Measured Channel 3 V & mV			Measured Channel 4 V & mV			Limits
			DMM 1	Mean (A)	Δ 1 Mean–DMM	DMM 2	Mean (B)	Δ 2 Mean–DMM	DMM 3	Mean (C)	Δ 3 Mean–DMM	DMM 4	Mean (D)	Δ 4 Mean–DMM	mV
5 mV	X 100	–1.5 V													±1.2
10 mV	X 100	–3.0 V													±1.6
20 mV	X 100	–6.0 V													±3.2
50 mV	X 10	–1.5V													±8
.1 V	X 10	–3.0 V													±16
1 V	X 1	–3.0 V													±160

Table 10 : DC 50Ω, Negative DC Accuracy Test Record

Volts /div.	Attenuator	P S Output	Measured Channel 1 V & mV			Measured Channel 2 V & mV			Measured Channel 3 V & mV			Measured Channel 4 V & mV			Limits
			DMM 1	Mean (A)	Δ 1 Mean–DMM	DMM 2	Mean (B)	Δ 2 Mean–DMM	DMM 3	Mean (C)	Δ 3 Mean–DMM	DMM 4	Mean (D)	Δ 4 Mean–DMM	mV
5 mV	X 100	–1.5 V													±1.2
.1 V	X 10	–3.0 V													±16
5 V	X 1	–15.0 V													±800

Table 11 : DC 1MΩ, Negative DC Accuracy Test Record

Coupling	DSO Offset	P S Output	Measured Channel 1 V & mV			Measured Channel 2 V & mV			Measured Channel 3 V & mV			Measured Channel 4 V & mV			Limits
DC			DMM 1	Mean (A)	Δ 1 Mean– DMM	DMM 2	Mean (B)	Δ 2 Mean– DMM	DMM 3	Mean (C)	Δ 3 Mean– DMM	DMM 4	Mean (D)	Δ 4 Mean– DMM	mV
50 Ω	+1 V	–1 V													±11.2
1 MΩ	+1 V	–1 V													±11.2

Table 12 : Positive Offset Test Record

Coupling	DSO Offset	P S Output	Measured Channel 1 V & mV			Measured Channel 2 V & mV			Measured Channel 3 V & mV			Measured Channel 4 V & mV			Limits
DC			DMM 1	Mean (A)	Δ 1 Mean– DMM	DMM 2	Mean (B)	Δ 2 Mean– DMM	DMM 3	Mean (C)	Δ 3 Mean– DMM	DMM 4	Mean (D)	Δ 4 Mean– DMM	mV
50 Ω	–1 V	+1 V													±11.2
1 MΩ	–1 V	+1 V													±11.2

Table 13 : Negative Offset Test Record

Frequency	Measured Power	Generator Amplitude	Measured Channel 1		Measured Channel 2		Measured Channel 3		Measured Channel 4		Lower Limit	Upper Limit
MHz	mW	mV	Sdev(1) mV	Ratio(1) to 0.3	Sdev(2) mV	Ratio(2) to 0.3	Sdev(3) mV	Ratio(3) to 0.3	Sdev(4) mV	Ratio(4) to 0.3		
0.300	0.200			N/A		N/A		N/A		N/A	N/A	N/A
1.1	0.200										0.94	1.06
30.1	0.200										0.94	1.06
250.1	0.200										0.88	1.13
750.1	0.200										0.84	1.18
1000.1	0.200										0.70	N/A

Table 14 : DC 50Ω, 50 mV/div. Bandwidth Test Record

Frequency	Measured Power	Generator Amplitude	Measured Channel 1		Measured Channel 2		Measured Channel 3		Measured Channel 4		Lower Limit	Upper Limit
MHz	mW	mV	Sdev(1) mV	Ratio(1) to 0.3	Sdev(2) mV	Ratio(2) to 0.3	Sdev(3) mV	Ratio(3) to 0.3	Sdev(4) mV	Ratio(4) to 0.3		
0.300	0.800			N/A		N/A		N/A		N/A	N/A	N/A
1.1	0.800										0.94	1.06
30.1	0.800										0.94	1.06
250.1	0.800										0.88	1.13
750.1	0.800										0.84	1.18
1000.1	0.800										0.70	N/A

Table 15 : DC 50Ω, 100 mV/div. Bandwidth Test Record

DSO Global BWL	Amplitude at 300 kHz	Measured Channel 1		Measured Channel 2		Measured Channel 3		Measured Channel 4		Lower Limit	Upper Limit
MHz	Sdev mV	Sdev(1) mV	Freq(1) MHz	Sdev(2) mV	Freq(2) MHz	Sdev(3) mV	Freq(3) MHz	Sdev(4) mV	Freq(4) MHz	MHz	MHz
25	200	140		140		140		140		10	37
200	200	140		140		140		140		110	290

Table 16 : DC 50Ω, Bandwidth Limiter Test Record

Frequency	Measured Channel 1		Measured Channel 2		Measured Channel 3		Measured Channel 4		Lower Limit
MHz	Sdev(1) mV	Ratio(1) to 0.3	Sdev(2) mV	Ratio(2) to 0.3	Sdev(3) mV	Ratio(3) to 0.3	Sdev(4) mV	Ratio(4) to 0.3	
0.300	200	N/A	200	N/A	200	N/A	200	N/A	N/A
400.1									0.7

Table 17 : DC 1MΩ, 100 mV/div. Bandwidth Test Record

Trigger Level	Trigger Slope	Channel 1	Channel 2	Channel 3	Channel 4	Lower Limit	Upper Limit
mV		Measured DC Trigger Level (1) mV	Measured DC Trigger Level (2) mV	Measured DC Trigger Level (3) mV	Measured DC Trigger Level (4) mV	mV	mV
0	Pos					–30	+30
0	Neg					–30	+ 30
+300	Pos					+270	+330
+300	Neg					+270	+330
–300	Pos					–270	–330
–300	Neg					–270	–330

Table 18 : Channel DC Trigger Test Record

Trigger Level	Trigger Slope	Channel 1	Channel 2	Channel 3	Channel 4	Lower Limit	Upper Limit
mV		Measured HFREJ Trigger Level (1) mV	Measured HFREJ Trigger Level (2) mV	Measured HFREJ Trigger Level (3) mV	Measured HFREJ Trigger Level (4) mV	mV	mV
0	Pos					–50	+50
0	Neg					–50	+ 50
+300	Pos					+250	+350
+300	Neg					+250	+350
–300	Pos					–250	–350
–300	Neg					–250	–350

Table 19 : Channel HFREJ Trigger Test Record

Trigger Slope	External Trigger Level	External DC	External HFREJ	External Limits		External/10 Trigger Level	External/10 DC	External/10 HFREJ	External/10 Limits	
		Measured DC Trigger Level (Ext)	Measured HFREJ Trigger Level (Ext)	Lower	Upper		Measured DC Trigger Level (Ext/10)	Measured HFREJ Trigger Level (Ext/10)	Lower	Upper
	mV	mV	mV	mV	mV	V	V	V	V	V
Pos	0			–50	+50	0			–0.5	+0.5
Neg	0			–50	+50	0			–0.5	+0.5
Pos	+300			+250	+350	+3			+2.5	+3.5
Neg	+300			+250	+350	+3			+2.5	+3.5
Pos	–300			–250	–350	–3			–2.5	–3.5
Neg	–300			–250	–350	–3			–2.5	–3.5

Table 20 : External & Ext/10 DC and HFREJ Trigger Test Record

Smart Trigger Pulse Width ns	Generator Frequency MHz	Width <	Width >	Triggered	Pass
< 10	100	On	Off	Yes	
< 10	100	Off	On	No	
> 10	40	Off	On	Yes	
> 10	40	On	Off	No	
< 100	10	On	Off	Yes	
< 100	10	Off	On	No	
> 100	4	Off	On	Yes	
> 100	4	On	Off	No	

Table 21 : Smart Trigger Test Record

Generator Frequency MHz	Post Trigger Delay msec	Delay (A) ns	Delay (1) msec	Difference delay(A) –delay(1)+5msec	Lower Limit µsec	Upper Limit µsec
1.00000	5.00000				-0.05	+0.05

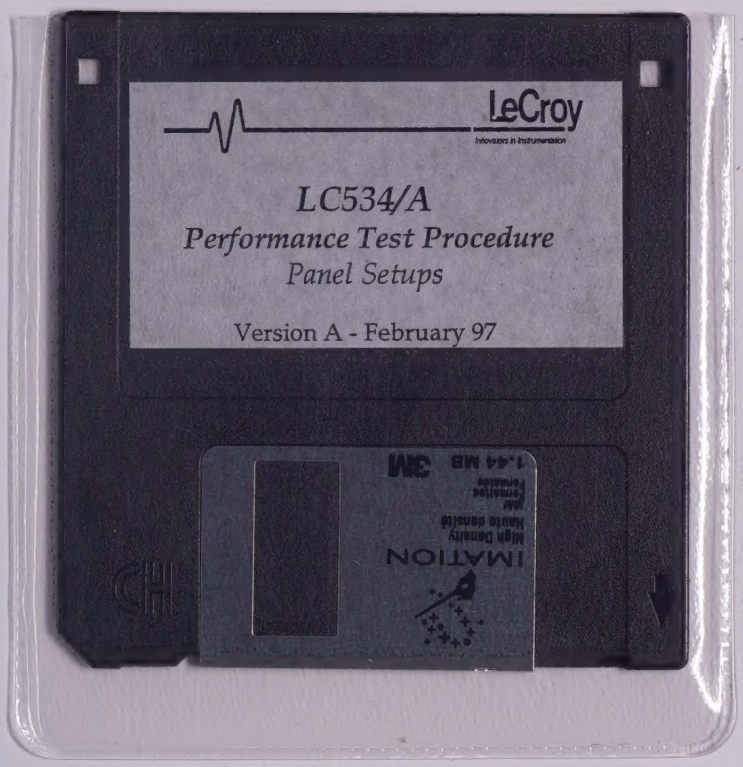
Table 22 : Time Base Test Record

Coupling	Measured Channel 1 Over+(A) %	Measured Channel 2 Over+(B) %	Measured Channel 3 Over+(C) %	Measured Channel 4 Over+%(D) %	Overshoot Limit %	Measured Channel 1 Rise(A) ns	Measured Channel 2 Rise(B) ns	Measured Channel 3 Rise(C) ns	Measured Channel 4 Rise(D) ns	Rise time Limit ns
DC 50Ω					0 to 20					0.5
DC 1MΩ					–7 to 20					1.6

Table 23 : Rise time and Overshoot Test Record

DC Reference Source Volt	Measured Channel 1 Overload Trip sec	Measured Channel 2 Overload Trip sec	Measured Channel 3 Overload Trip sec	Measured Channel 4 Overload Trip sec	Measured External Overload Trip sec	Overload Trip Limit sec
7.07						< 17
5.00						> 35

Table 24 : Overload Trip Test Record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